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Department
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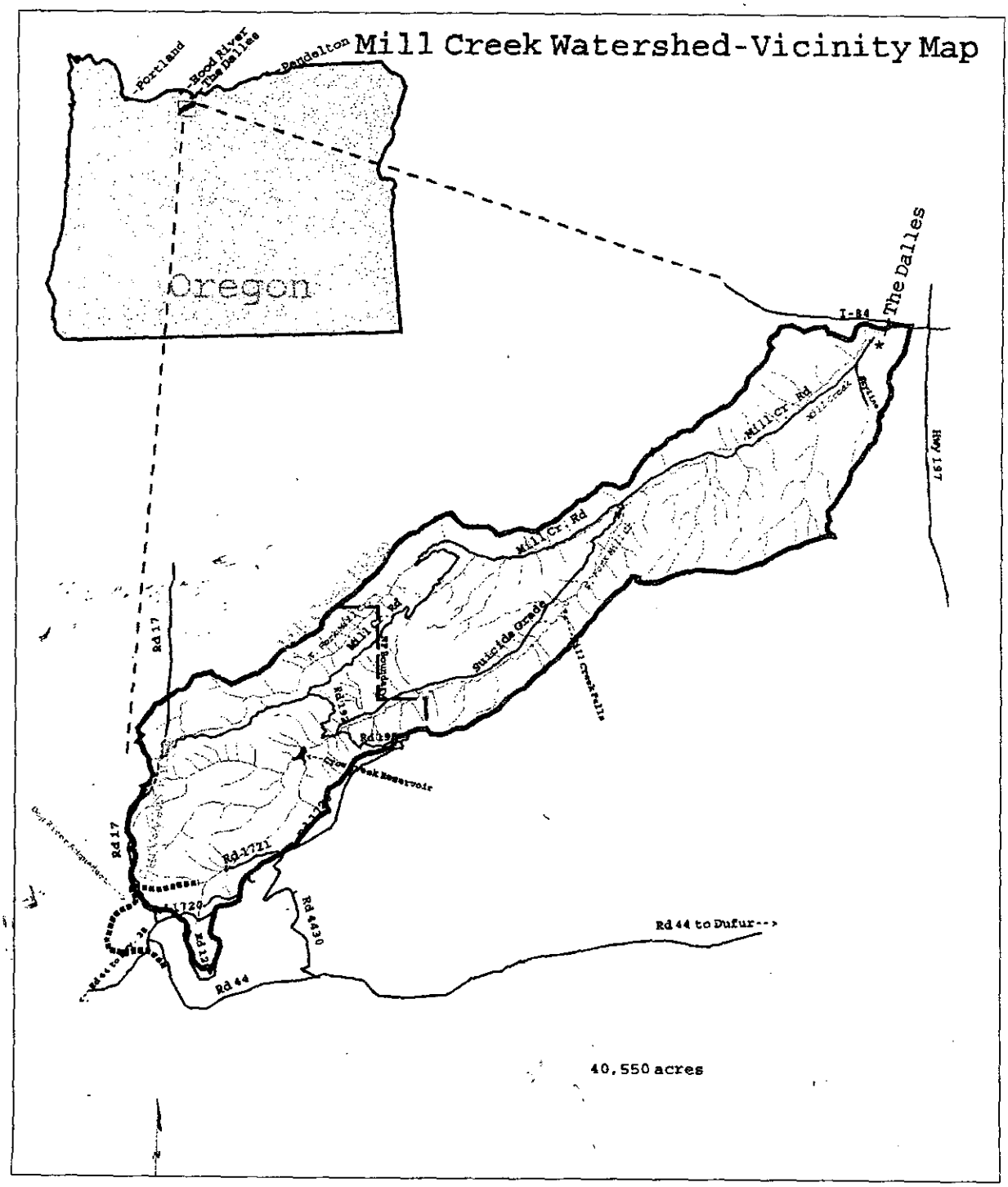
Forest
Service

**Pacific
Northwest
Region**

2000

Mill Creek Watershed Analysis



Mt. Hood National Forest

Preface

In April 1993, President Clinton commissioned an interagency scientific team to develop a set of alternatives for management of forested ecosystems within the range of the northern spotted owl. This effort culminated in the report by the Forest Ecosystem Management Assessment Team (FEMAT) entitled *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* July 1993.

Due to accelerating concerns about declining fish resources, protection and improvement of aquatic and riparian ecosystems are key components of the FEMAT report, which presents a broad strategy for maintaining and restoring the distribution, diversity, and complexity of watershed and landscape-scale processes and characteristics under which aquatic species have evolved. The report also identifies and describes land allocations and standards and guidelines designed to meet specific management objectives. The report **describes a four element Aquatic conservation strategy (ACS): Riparian reserves, key watersheds, watershed analysis, and restoration.**

The Record of Decision (ROD) confirmed that a landscape-level analysis of the various components and interrelationships in the ecosystem will be the tool for developing future land management programs and projects. The ROD refers to this landscape level-analysis as a "Watershed Analysis" (WA).

The action described in the ROD amends all existing Forest Service and Bureau of Land Management documents for the areas and resources covered by the supplemental Environmental Impact Statement (SEIS). This new management direction will apply to projects that will be conducted after site-specific environmental analysis.

Although the PIG (Policy and Implementation Guide, for Columbia River basin anadromous fish habitat management) is not directly mentioned in the ROD, watershed analysis and resulting recommendations for implementing the ACS are designed to restore and protect salmon and steelhead habitat on federal lands within the range of Pacific ocean anadromy over time.

What Watershed Analysis does and does not do.

As described above, Watershed Analysis is one of four components of the Aquatic Conservation Strategy. It provides decision makers with a scientific assessment of processes within and surrounding a watershed to support planning, as well as a baseline from which to assess maintaining or restoring the condition of aquatic, riparian and terrestrial habitats. Watershed Analysis is required in key watersheds and roadless areas prior to management, and recommends Riparian Reserve widths in all watersheds.

Watershed Analysis does not establish the final boundaries of Riparian Reserves, as they are established during site-specific project planning. Rather, the role of watershed analysis is to provide the information needed to decide how to delineate Riparian Reserves.

Watershed Analysis will be the mechanism to support ecosystem management at approximately 20 to 200 square mile watershed level, including terrestrial, riparian, aquatic, and social issues. It will focus on collecting and compiling information within the watershed that is essential for making sound management decisions. Although inventory is not part of watershed analysis, existing inventory data will be useful in an analysis for prioritizing and designing future inventories, as well as providing for the basis for developing project-specific proposals, monitoring and restoration programs. It does not take the place of project-level data-gathering and analysis.

Watershed Analysis is a technically rigorous procedure with the purpose of developing and documenting a scientifically-based understanding of the ecological structures, functions, processes and interactions occurring within the watershed. Some of these include beneficial uses; vegetative patterns and distribution; flow phenomena such as vegetative corridors, streams, and riparian corridors; wind; fire (wild and prescribed fire, and fire suppression); wildlife migration routes; dispersal habitat; terrestrial vertebrate distribution; locally significant habitats; human use

patterns throughout the ecosystem; cumulative effects; and hydrology. The number and detail of these aspects considered will depend on the issues pertaining to a given watershed.

Threatened and Endangered Species

The Endangered Species Act (ESA) directs that a program to conserve fish, wildlife, and plants, including those listed as threatened or endangered, be established and implemented. The selected alternative of the Northwest Forest Plan is designed to provide for the continued existence of threatened and endangered species. Consultation on the plan was conducted with the Fish and Wildlife Service and the National Marine Fisheries Service in accordance with Section 7 of the ESA.

The ESA requires that consultations occur on actions, but not on analysis. A watershed analysis does not make decisions, and does not result in any activities or actions, that would require consultation.

Anadromous Fish

Evaluating the viability of anadromous fishes must be done at the regional scale. In 1993, the Scientific Analysis Team (SAT) completed their report called: "*Viability Assessments and Management Considerations for Species Associated With Late-Successional and Old-Growth Forests in the Pacific Northwest.*" The SAT report includes recommendations of the Pacific Salmon Working Group, also known as PACfish. Another recommendation of the SAT report included: initiating comprehensive watershed restoration measures in watersheds with priority given to those having the greatest potential to provide high quality fish habitat (i.e. Tier 1 key watersheds, ROD 1994).

Old-Growth Ecosystems

The standards and guidelines described in the ROD are designed to:

- Maintain late-successional and old-growth species habitat and ecosystems of federal lands.
- Maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations.

Watershed Analysis at the watershed/subwatershed level should provide a finely tuned assessment of habitat capability within the Late-Successional Reserves (LSR), as well as the current dispersal conditions between the LSRs. This process will help locate areas of concern that were not possible to identify through the large scale, course grained assessment made at the Regional level for the ROD (1994).

River Basin Planning and Beyond

Watershed Analysis should also be set in the context of larger landscapes (e.g. river basins, Provinces, and Regions) in order to coordinate with regional strategies of management and restoration, and to integrate large-scale processes that may be difficult to measure at a watershed scale.

River Basin Assessments: Within a hydrologic Province (thousands of square miles):

- Identifies values and issues within a River Basin.
- Describes the dominant physical processes within the River Basin and interactions between ecosystem components.
- Identifies watersheds and the sequence of analysis.

In the absence of Province-level assessments, the Mt. Hood National Forest undertook a project to gather large-scale information called "PULSE". The PULSE effort provided information at the Forest-level to develop the ecological and human components within the Forest context.

Project Planning

Resource Management activities following Watershed Analysis will be the subject to site-specific environmental analysis and appropriate public participation. This will involve analysis of cumulative and other environmental effects.

The Watershed Analysis process includes informal public participation involving government, tribal, adjacent landowners, private organizations, industry, and interested citizens. If a NEPA analysis utilizes information from a watershed analysis, the information will be available for public review during the NEPA process for the project.

In some cases, the importance of new data or changing issues may make it useful to re-evaluate parts of the original Watershed Analysis or update the entire document. A watershed analysis should thus be considered an open file and a dynamic document that is never "complete".

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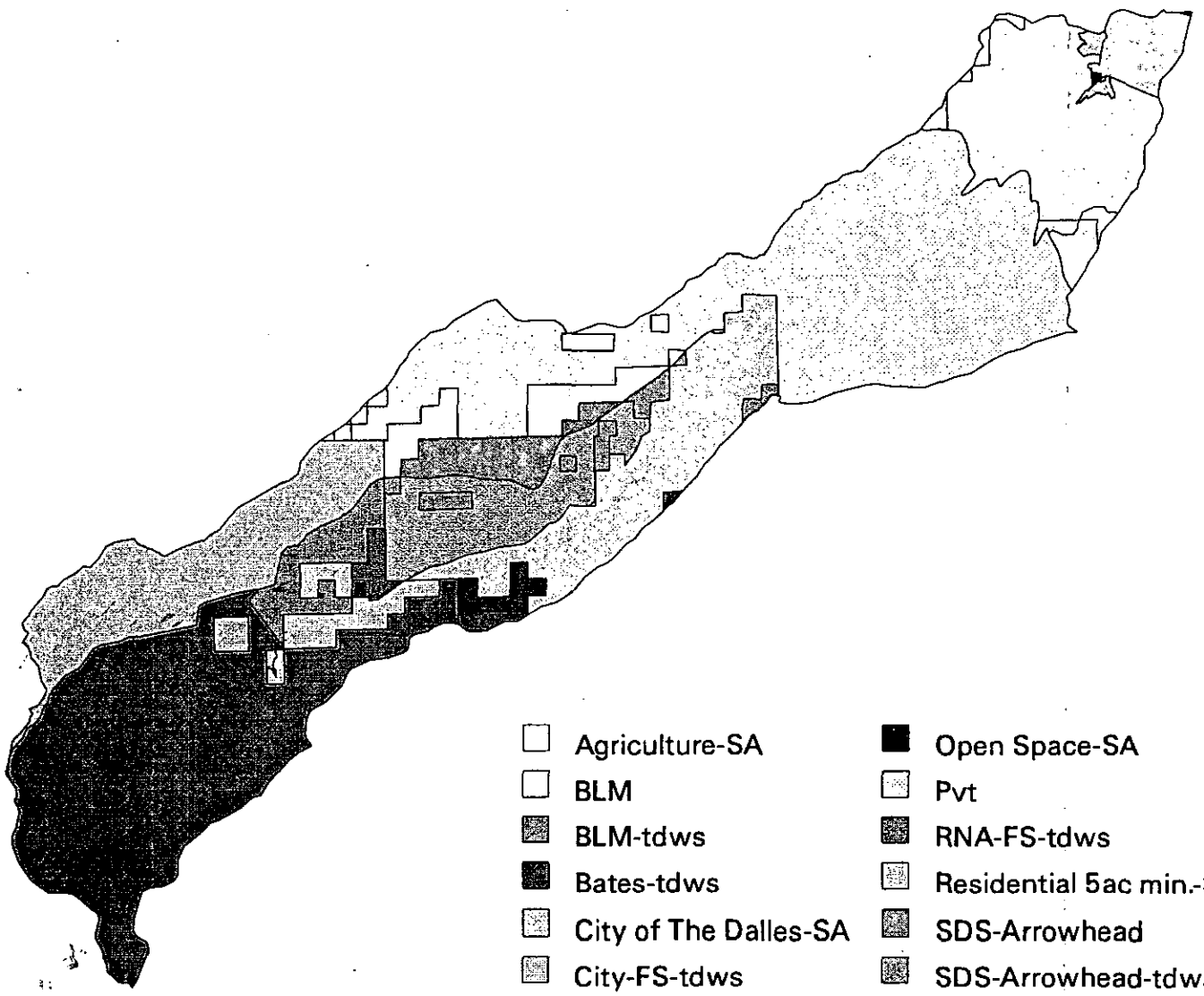
Chapter I

Figure 1-1

Mill Creek Watershed Land Status



Key

SA - Scenic Area

FS - Forest Service

tdws - The Dalles Watershed

BLM - Bureau of Land Mngt.

RNA - Research Nat. Area

Chapter I Introduction

In 1994 the Pacific Northwest Forest Plan initiated under the guidance of the Aquatic Conservation Strategy (Record of Decision, ROD 1994) a systematic procedure to characterize the aquatic, riparian, and terrestrial features within a watershed. This process is called "Watershed Analysis". Managers will use this information to refine riparian reserve boundaries, prescribe land management activities including watershed restoration, and develop monitoring programs. Like monitoring, assessment is a continuous process. This report is a first approximation; it will be revised as we learn more and as conditions and needs change.

Previous analysis pertinent and contributory to this assessment are:

- **Mt. Hood National Forest Plan** - 1991, as amended by the Northwest Forest Plan.
- **Mile Creeks Watershed Analysis** - 1994, Analyzed the Mile Creeks subbasin as a tier 1 key watershed under the Northwest Forest Plan.
- **East and Middle Fork Hood River Watershed Analysis** - 1996, Analyzed the East and Middle Fork of Hood River sub-basins as a tier 1 key watershed under the Northwest Forest Plan.
- **White River Watershed Analysis** - 1995, Analyzed the White River subbasin as a tier 2 key watershed under the NorthwestForest Plan.
- **Access and Travel Management Plan** - 1995, ATM plan.
- **Surveyors Ridge LSRA** - 1997, Analyzed the Surveyors Ridge and Fifteenmile Creek drainage from October 1994 to July1997.

The area used for analysis is roughly the Mill Creek watershed and its surrounding environs. The watershed is comprised of 40,550 acres of which 15,298 acres lies within the Mt. Hood National Forest boundary.

Our Objectives

The objectives of the assessment are the following:

- Recommend riparian reserve widths.
- Recommend land management activities which will include watershed restoration.
- Develop a monitoring program for the watershed.
- Prioritize management action where improvement of function is possible through management while indicating necessary mitigation, design parameters and monitoring needs.

Context of Mill Creek Watershed

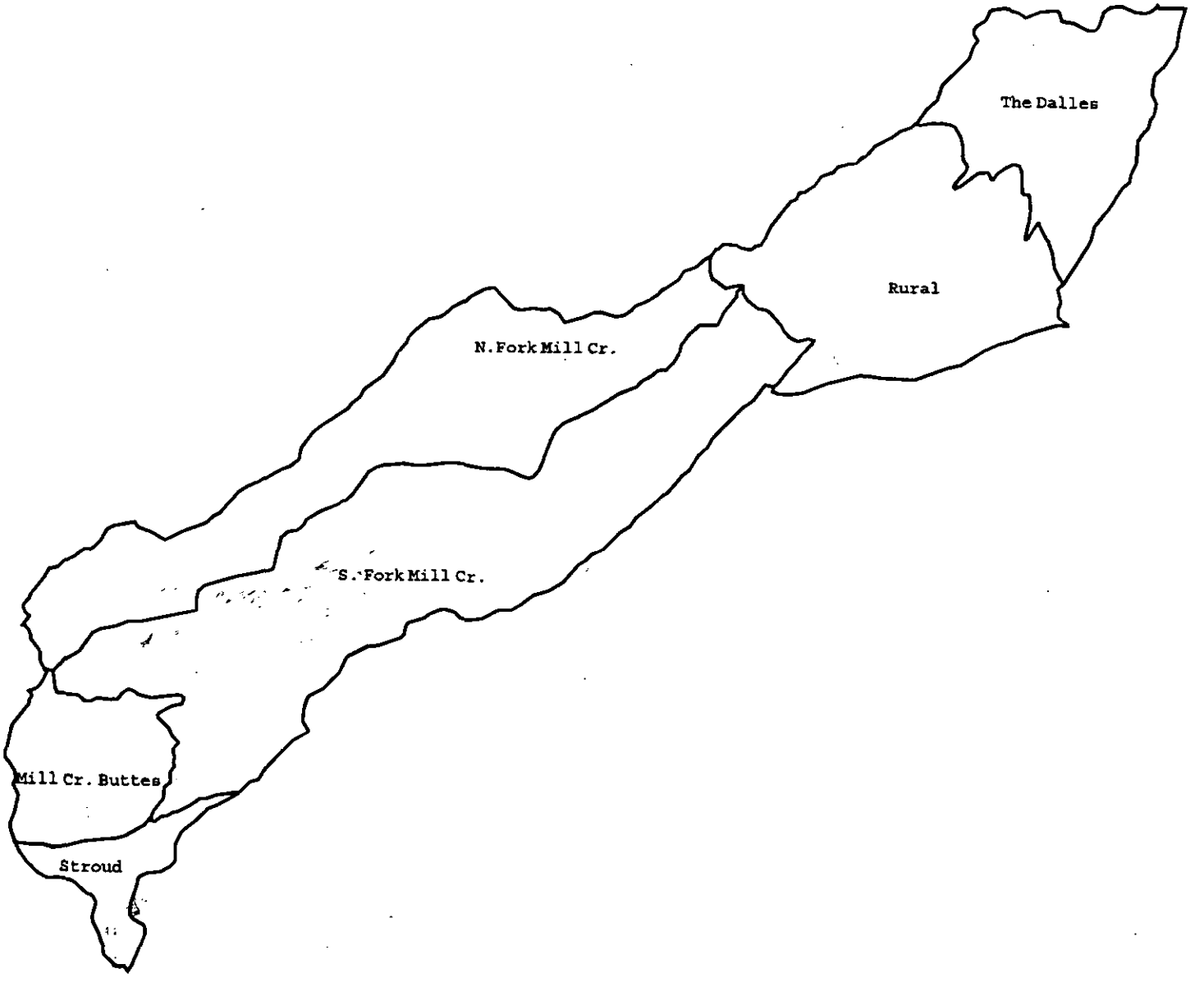
Mill Creek watershed is a very diverse watershed. The people who live within the watershed, the plants and wildlife, the water resources, the agricultural crops, and the climate changes brought about by extremes in the distribution of precipitation and varying terrain across the landscape, all contribute to the rich diversity (see figure 1-1). The watershed encompasses all 3 climate zones for this area (Eastside, Transition, and Crest). Elevations range from the top of Mill Creek Butte (4,913 ft) down to the mouth of Mill Creek where it enters the Columbia River (approx. 94 ft). Growing conditions created by the extremes of climate and terrain provide for a wide variety of vegetation, from pacific silver fir, to open grass steppe lands. The orientation of the drainage lies SW to NE. Mill Creek historically was important to native Americans as well as Euro-American settlers. The watershed had ample natural resources and was used as an early travel route to interior valleys to the west. Several types of agricultural products are produced within this watershed (i.e. wheat, cherries, cattle). Historically timber/wood production has played a major role in this

watershed, but plays a smaller role today. One of the most important commodities to come from this watershed is *high quality drinking water for the city of* The Dalles. Mill Creek is the main source of drinking water for The Dalles. Additionally, millions of gallons of water are diverted from Dog River (see figure 2-1), (which would normally drain into the East Fork of Hood River), into the South Fork of Mill Creek, as part of the city's water supply. Aquatic and terrestrial wildlife are also dependent on the water resources. Approximately 4,317 acres of the upper reaches of the watershed, (which constitutes most of the headwaters), lie within the Surveyors Ridge Late-Successional Reserve (LSR). The North Fork of Mill Creek is the only major tributary in the Mill Creek stream network that does not fall within the LSR.

It should be noted here that for the purposes of providing more specific information about this watershed, and to locate the readers as to where the specific areas are on the ground, we had to further aggregate the landscape units (LU's), (see figure 1-2), in this watershed from how they might have been described in other documents that referenced this area. Those documents would include the Mile Creek Watershed Analysis and Surveyors Ridge Late Successional Reserve Analysis (LSRA).

Figure 1-2

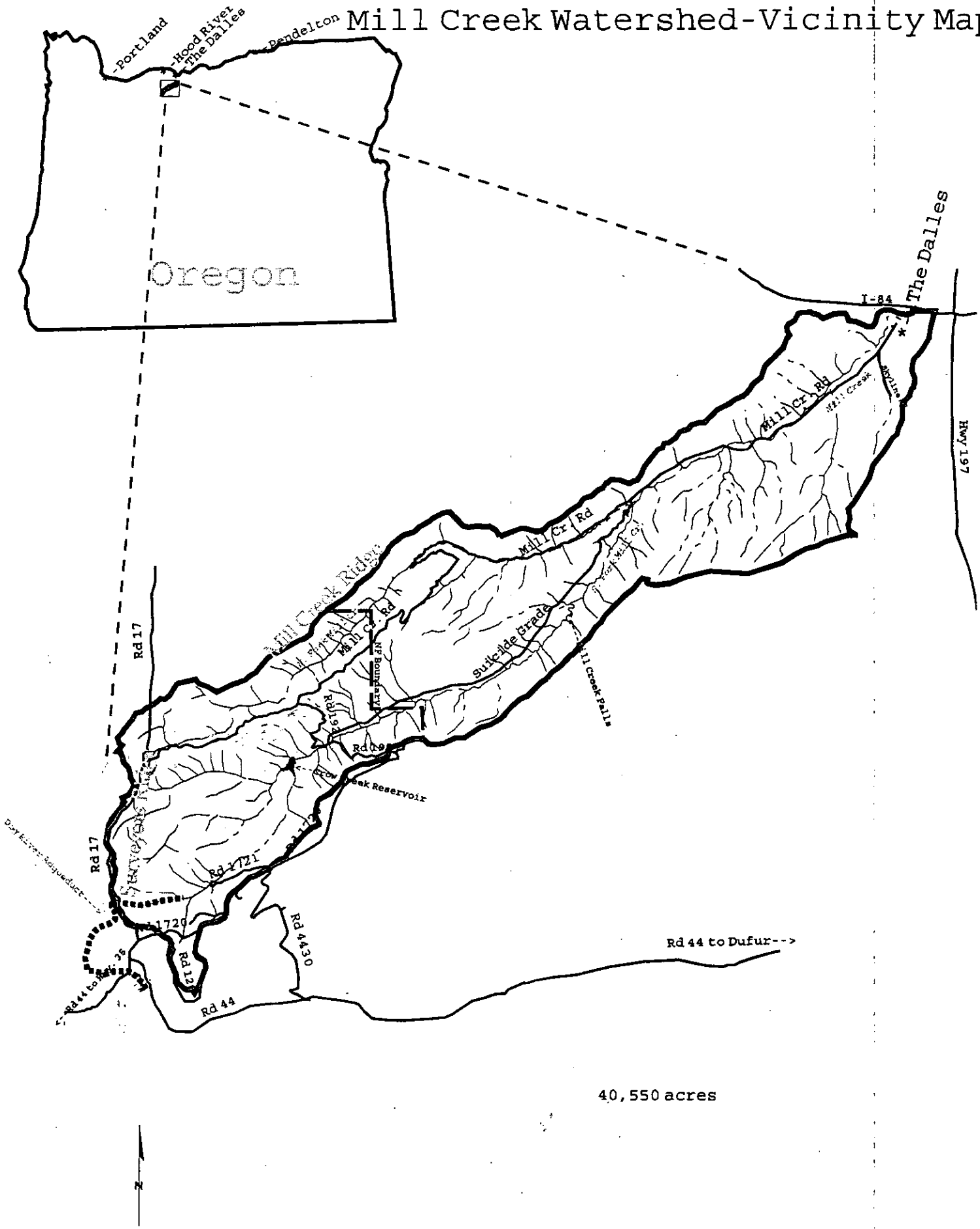
Mill Creek Watershed Landscape Units



Chapter II

Figure 2-1

Mill Creek Watershed-Vicinity Map



Chapter II: General Information and description of Mill Creek Watershed

Mill Creek watershed is oriented in a southwest to northeast direction (see figure 2-1). Its headwaters are located approximately 18 miles south of Hood River at Mill Creek Buttes, where the elevation is roughly 4900 feet above sea level. The distal end of the watershed is located at The Dalles where Mill Creek joins the Columbia River at an elevation of approximately 120 feet above sea level. The watershed is bordered to the west by the East Fork of Hood River watershed, to the south and east by Mile Creeks watershed, and to the north by an assemblage of small tributaries of the Columbia River. The land is owned and managed by a variety of federal agencies, state, and private citizens. The Forest Service owns and manages only 38% (approx. 15,298 ac) of the watershed and most of that is also covered by The Dalles Municipal Watershed boundaries. The Forest Service areas encompass the headwaters of both the North and South Forks of Mill Creek, and include Crow Creek and its tributaries.

Prehistoric and Historic conditions:

The somewhat hidden Dalles Syncline, an elongated down-fold of the underlying bedrock parallels Mill Creek. Forming Mill Creek Ridge and trending in a somewhat northerly direction is Mill Creek Ridge anticline, a relatively narrow sharp upfold that may have formed as a result of thrusting from nearby Chenoweth Fault. Although Chenoweth Fault lies north of the watershed, three minor faults are exposed within the watershed where they cross Mill Creek, and outside the watershed where they cross Brown Creek.

The watershed is underlain by thousands of feet of Columbia River Basalt flows. Individual flows range in thickness from tens of feet to a few hundred feet. Several important interbeds are present between flows, and it is from these locations that groundwater is typically sought. The Columbia River Basalt is overlain by up to 1000 feet of volcaniclastic strata known as The Dalles Formation.

Glacial floods affected the lower portion of the watershed dozens of times during the Pleistocene. The Missoula Floods [1] were of such magnitude that flood waters at The Dalles were impounded to a depth of 1200 feet. The flood waters scoured the landscape below this elevation and left extensive glaciofluvial deposits throughout the lower portion of the watershed. These deposits generally became thinner and finer with increasing elevation and distance from the Columbia. (NGS, INC.1995)

As described above the origins of Mill Creek watershed were often violent and dramatic but major changes to the landscape did not stop there. With the introduction of humans into the area, change beyond that of the watersheds origins came and still occur to this day.

Because few professional excavations have been done in this watershed, there is no recognized cultural timeline particular to Mill Creek area. There are, however, any number of such timelines for the region. Most share enough similarity that the interrelationships are easily observable. Dates are approximate.

Some of the first travelers residing in the area of the Mill Creek Watershed would have been subjected to the Missoula/Bretz floods. These torrents would have disrupted the lives of humans and animal populations as well as any campsites in the area. Direct evidence of Paleoindians is rare but early finds in the area include two clovis points from The Dalles-Deschutes area and a campsite near the mouth of Fivemile Creek dating to at least 9,800 years ago and possibly several thousand years before then.

As the climate became hotter and drier 8500-5500 years ago, some sections of Mill Creek watershed may have been regularly utilized during this period. Closed canopy forest, parklands, meadows, lakes, and rivers with associated riparian areas would have resources available at least seasonally.

Between 5500-2500 years ago populations developed a semi-sedentary foraging and collecting strategy, analogous to the rise of agriculture elsewhere. The warmer drier climate during this time continued to restrict the amount of territory available to inhabitants. The first houses documented in the region date to between 5500 to 5000 years ago. All of these were semi-subterranean: the walls and roof were built over a hole dug in the ground.

[1] The Missoula Floods (also know as the Bretz Floods, named after the man who in 1920s first proposed the theory of catastrophic floods occurring from Lake Missoula). Lake Missoula was an ancient lake formed by ice jams that appear to have repeatedly filled and breached between 15,000 and 13,000 years ago, flooding across Washington and Oregon)

Shortly before 2500 to 500 years ago the climate again became cooler and wetter, with local and short term fluctuations. Plants and animals re-entered areas abandoned during more severe drought conditions. Once sporadically inhabited sites near the Columbia were reinhabited and once more became important settlements.

The groups that most commonly visited the Mill Creek watershed area were probably the Hood River and The Dalles Chinookans, also known as the Wascos, and the Tenino. Although the two groups lived in villages only six miles apart, they spoke distinctly different languages. Prior to forming the reservations, the lands north and east of Mt. Jefferson, extending along the crest of the Cascades to Mt. Hood and down across the Hood River Valley to the Columbia River formed the western edge of 6.5 million acres of traditional lands used by these people. These traditional use lands (including Mill Creek Watershed) exclusive of current reservation boundaries, were ceded to the U.S. Government in a 1855 treaty with by tribes of Middle Oregon. Special rights to fishing, hunting, gathering roots and berries, and pasturing stock"in unclaimed lands, in common with citizens", are provisions of the treaty. Following the treaty most of the Chinookans and Tenino were moved to the Warm Springs Reservation

About 500 years ago begins the arrival of the Euro-Americans and Russians onto the continent. This period is characterized by instability and disease. Because of its location along the Columbia River travel routes, The Dalles became a major trade center for American Indians and Euro-Americans, which resulted in the exposure of the native people to a succession of disease epidemics.

Trade and immigration networks were far reaching by this time. Use of Mill Creek watershed was probably intensely appealing to the first Euro-American inhabitants for many of the same reasons that had attracted American Indians. Seasonal and semi-permanent villages may have been built in various locations around the mouth, on the flats, within sheltered riparian areas, and near upland prairies and meadows. Numerous trails along tributaries of Mill Creek and waterways north and south ended along the ridge (Surveyors Ridge) overlooking the Hood River Valley.

We believe local tribal groups burned the area frequently for a variety of purposes, such as maintaining travelways, access to seasonal hunting areas, and promoting the growth and abundance of culturally important plants, particularly to areas along Surveyors Ridge. Nothing specific has been documented in the Mill Creek watershed, but it has been alluded to in early letters from the Forest Service. In addition, this type of activity has been documented throughout the western United States and we can find no reason why it would not have occurred here. Diaries and letters suggest that early settlers copied many of the American Indian burning practices, particularly to maintain travelways and pasturage.

Important traditional plants of the Tribes of Warm Springs are included in a report titled "The Preservation and Management of Cultural Plants on the Warm Springs Indian Reservation; A Proposal", by botanist R.Helliwell. This document identifies five root plants that are currently among the most important cultural foods, including Camas (*Cammassia quamish*), Bitteroot (*Lewisia rediviva*), Biscuit root (*Lomatium cous*), Canby's desert parsley (*Lomatium canbi*), and Indian Carrot (*Perideridia gairdneri*). In addition, deer, elk and game of all sizes were important foods obtained in the watershed and processed for use. Intentional burning to keep underbrush from travel routes and maintain huckleberry (*Vaccinium spp.*) patches is well documented. Peeled cedars, the bark of which was used in basketry and clothing, are found in this watershed. Mill Creek watershed also contains a number of rock features, although some may have had Euro-American origins.

Throughout the year fish were caught in tributaries and in the main forks of Mill Creek. Camps used for longer terms may have been situated on the creek close to the mouth with the Columbia River to take advantage of the salmon runs, or placed further back in a more sheltered location.

Initial exploration was done by Lewis and Clark in 1805. They saw no encampments along the southern shore of the Columbia in the vicinity of Mill Creek, which the American Indians called Quennet (various spellings), but they themselves camped there for a few days in October 1805 and again in April of 1806. They called their campsite Fort Camp or Fort Rock Camp. In the 1820s the Hudson Bay company tried to establish a trading post to the east of the present day The Dalles (illustrated 1905), and even constructed a sawmill on Mill Creek to meet their needs (Beekham et al 1888). Short lived, the post was abandoned when the company decided to maintain its store further downstream.

Between 1800-1830, some of the first Euro-Americans to enter the Pacific Northwest were missionaries. In 1838, Reverend Lee sent his nephew, Daniel Lee, and Henry Perkins to found the Methodist mission along the Columbia. They built the first permanent housing at the mouth of Mill Creek called Wascopam, or place of the Wascos.

In 1850 a permanent military post named Fort Drum replaced Wascopam. The population of the Oregon territory increased dramatically between 1850 and 1860 in response to the lands act of 1850 and 1855. In 1850, the government sent surveyors to map the area around Fort Drum. They used a large rock at the mouth of Mill Creek, called Witness or Harbor Rock, as their datum.

In 1853 the name Quennet changed to Mill Creek. In 1854, Wasco County was created, originally containing parts of the present day states of Idaho, Montana, Wyoming and Washington, besides 17 of Oregons counties (Illustrated 1905; Donovan 1994). The Dalles was named the county seat. In 1855, the town was platted as Dalles city and incorporated two years later.

Several commercial businesses began to spring up at this time. Some of the most notable ones are; cordwood, lumber (2 mills, with one on Mill Creek), farming, orchards, dairy, cattle, and sheep. Chinese immigrants made their first appearance before 1860. Within a few years there were 6 mills on Mill Creek. A lumber transport flume was constructed from the site known as John's Mill Lake (later would become part of Crow Creek Reservoir) down to a site in The Dalles. A flume was built in the late 1880's and not only transported logs but also provided irrigation, washing, and drinking water to local residents.

In 1862, James Reynolds was granted a franchise to lay water pipe for the City of The Dalles using Mill Creek as the source of that supply. The same year he transferred the contract to Robert Pentland, who actually built and operated the system.

Closer to the headwaters, miners, farmers, and trappers lived along Surveyors Ridge in Gibson Prairie, near Brooks Meadow, or the rough terrain in-between. After the gold rush of the 1860s stage and wagon roads were built and steamboats carrying goods and passengers along the Columbia were popular with ever-increasing recreational activities. Wheat production surpassed that of cattle in drier acreage east of The Dalles. In the 1880s, the community of Mill Creek was developed as a company town to harvest timber in Mill Creek watershed. When the company was started in 1884, the timber projected was said to be "inexhaustible".

Local residents fished in the South Fork Mill Creek in the early 1900s and fishing was considered a popular pastime (Bailey 1972). The Dalles watershed was given protected status as a domestic source of water in 1912 and at the time fishing was banned above Mill Creek Falls (see figure 2-1, on the South Fork of Mill Creek, southwest to west of Wicks Treatment plant). More than likely fishing occurred below the falls, for both resident and steelhead trout, both by indigenous people and white settlers. Commercial fishing was well underway in the Columbia River prior to 1900 and likely impacted local anadromous fish runs. Crow Creek Dam was constructed in 1967, covering what had been known as John's Mill Lake. The reservoir is a 28 acre impoundment at 2600 feet in elevation with a maximum depth of 65 feet. The reservoir has two inlets: Crow Creek (which includes Alder Creek), and the South Fork of Mill Creek (which includes the Dog River aqueduct), but only has one outlet. The dam stores water providing drinking water for the City of The Dalles. (See appendix B for more information on the cultural resources of Mill Creek watershed.)

Geology

Sixteen geologic units have been identified during previous geologic mapping of Mill Creek watershed. These units are listed and described in Appendix A, along with overall landslide potential, sediment transport, sediment delivery, rock types, and slope forming processes.

Like many watersheds in the Cascade mountains, the key factors that contribute to landslides in Mill Creek are steep slopes, abundant precipitation, and weak geologic features (see figure 2-2). However, unlike watersheds west of the Cascade crest, Mill Creek watershed receives only about 15 to 45 inches of precipitation per year. (Mean annual precipitation at The Dalles over the last five decades is 14.7 inches.) In addition, only a small percentage of the

watershed consists of steep slopes, and many of these are comprised of rock that is relatively resistant to slope failure.However, landslides do occur, and they tend to do so in locations where several of the above conditions are met. Inner gorges and colluvial hollows are one such location having a predisposition toward landsliding. Tributary channels may also be included in this category since they often act like colluvial hollows and collect debris introduced by headward erosion or deposited by stream-bank failures. Episodes of peak flow associated with large storms or rain-on-snow events typically mobilize this debris.

Thirty-six landslides were identified in the Mill Creek landslide inventory (table V, Appendix A). Of these, 31 occurred within the period of photo record which dates back to 1946. The 5 remaining slides are considered to be ancient and are only visible because their scarps and/or deposits are quite large. Of the recent landslides, 20 are debris flows, 7 are debris slides, 1 is a rockfall, and 3 are stream-bank failures. Separating the slides by landuse indicates that 2 are associated with roads, 1 with non-forested land, and the remaining 28 appear to be associated with unmanaged forest lands. In addition, 30 of these appear to have delivered sediment to streams. A majority of the first and second order stream channels in Mill Creek watershed are subject to severe stream-bank erosion and flooding.

Invariably, north-facing valley walls are better vegetated than valley walls with other aspects. South-facing valley walls in the lower portion of the watershed are often completely devoid of conifers. Slopes where vegetation is sparse appear to have a greater propensity for landsliding. South-facing slopes in North Fork Mill Creek valley are severely dissected by channels sharing debris flows and emphermeral streams. The deposits of these debris flows appear to be coarse grained and have very short runout zones, even after the narrowness of their respective valleys is taken into consideration. Stream-bank failures are probably the most common type of landslides in the area.

Throughout the watershed and in neighboring areas, groundwater appears to have been abundant historically. More recently, however, with steady development of water-intensive agriculture (orchards and row crops), groundwater levels throughout the region and with at least one basalt aquifer along Mill Creek have showed consistent decline. Certain geologic conditions within the watershed are inherently unstable and merit special attention during field investigations. These are listed in appendix A, page 8 .

Soils

Since Mill Creek is a key component of a municipal watershed, water quality is a very high concern.

87% of Mill watershed is in either a low or moderate erosion hazard (see figure 2-3). Only 13% of the analysis area is in the high category, a good portion of which is in the steep terrain of the North Fork Mill Creek canyon upstream from the National Forest boundary. Also of interest is that virtually all of the drainage network flows though areas mapped with a moderate or high erosion hazard.

84% of the area is in either a high or a moderate soil resiliency class. Only 16% of the analysis area is in a low resiliency class, most of which includes dry meadow or open woodland types, which recover from damage very slowly. Productivity ties closely to soil resiliency. For example, lands with the lowest productivity are the ones with low to moderate resiliency due to one or more factors holding back the optimal growth or directing the type of vegetation on a particular site (i.e. grasslands vs forested). Conversely, better growing sites have moderate to high resiliency. In general, the most productive sites within the watershed tend to be in riparian areas or on North aspects within the 2500-4000ft elevation band where conditions such as adequate precipitation, temperature, and deep ashy soils predominate. Southerly aspects in the watershed tend to have shallow rocky soils and harsher temperature extremes (doughty sites) and therefore produce lower vegetative biomass. (see appendix C)

Figure 2-2

Mill Creek Watershed Relative Landslide Suseptability

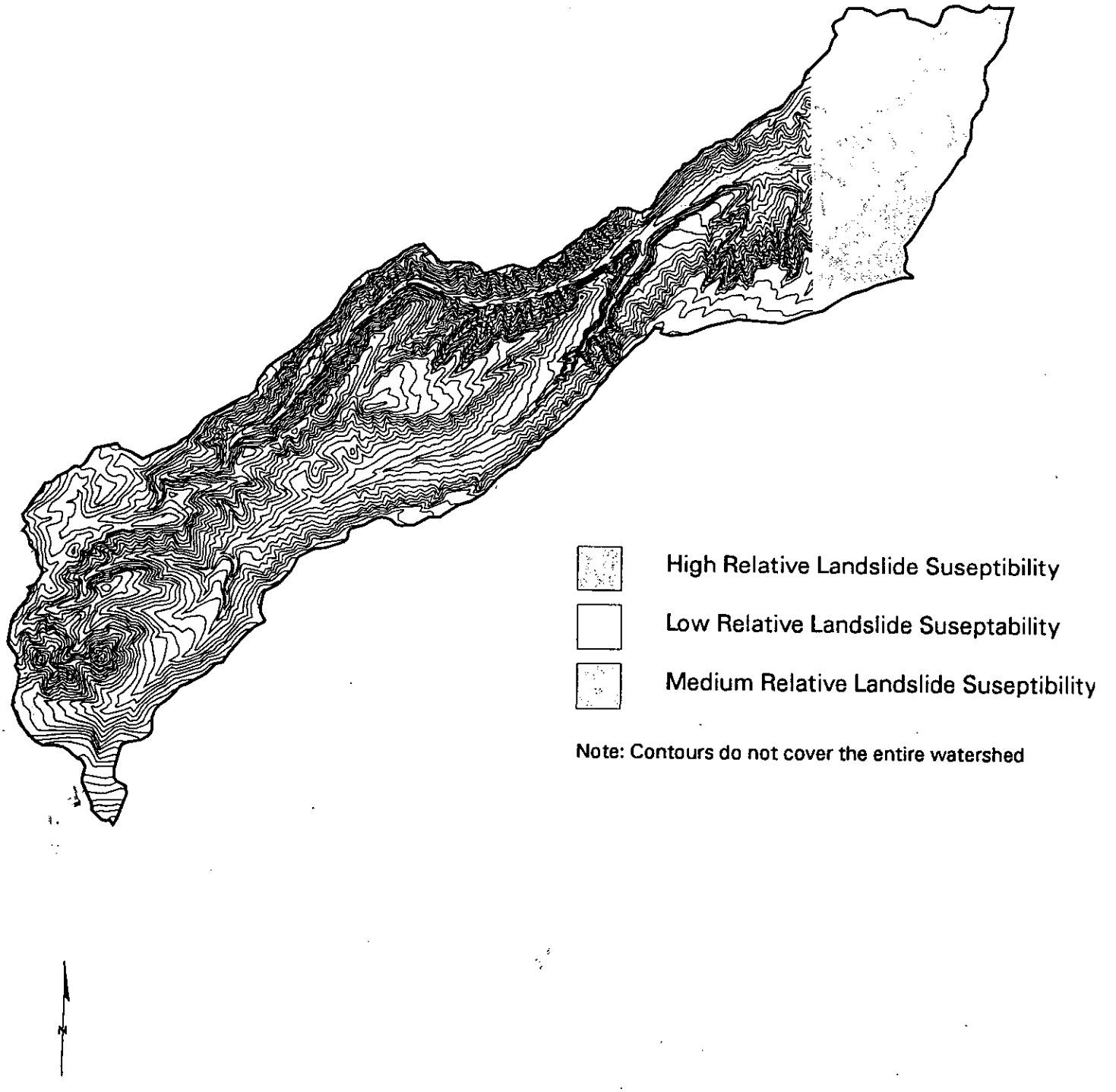


Figure 2-3

Mill Creek Watershed Erosion Hazard

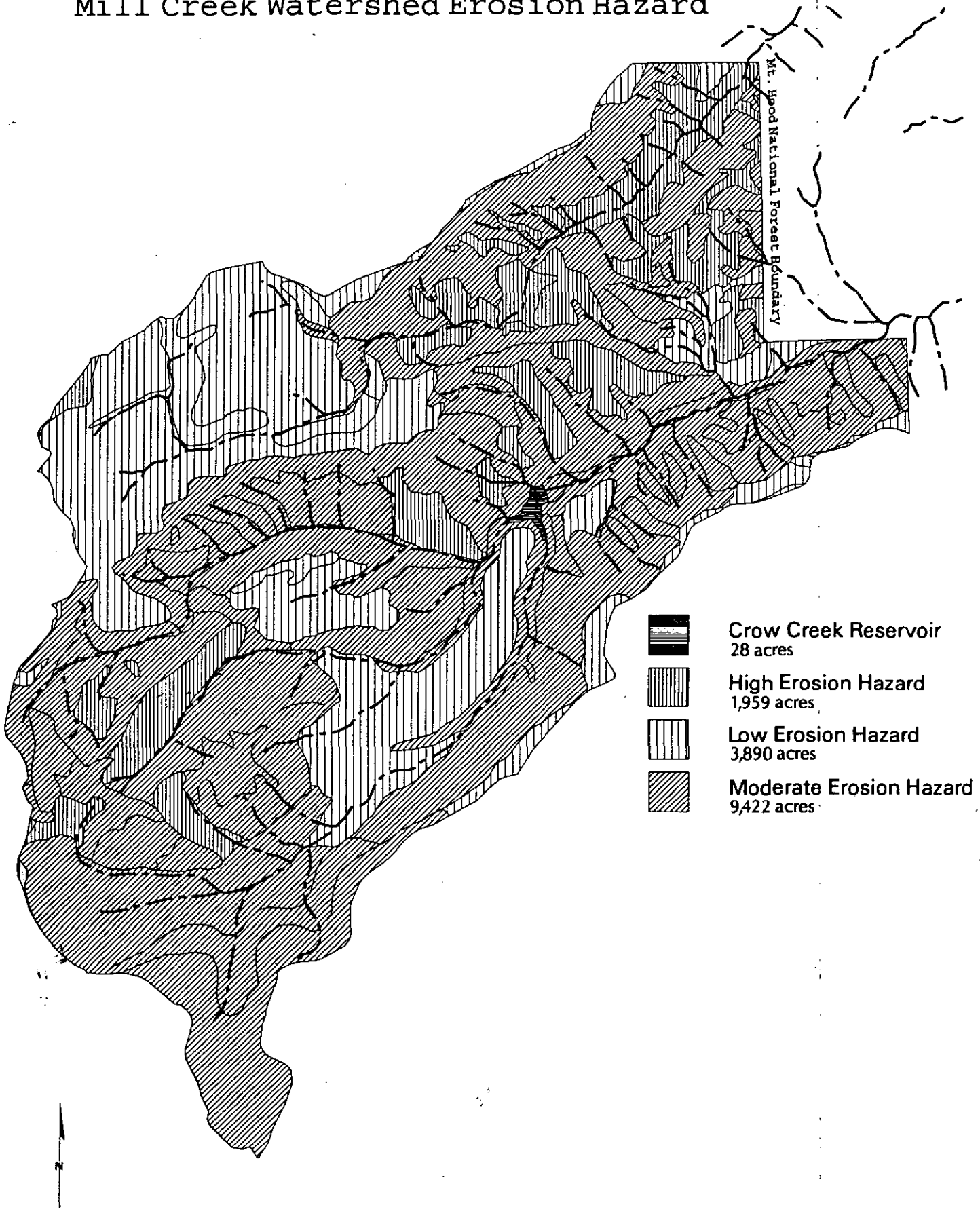
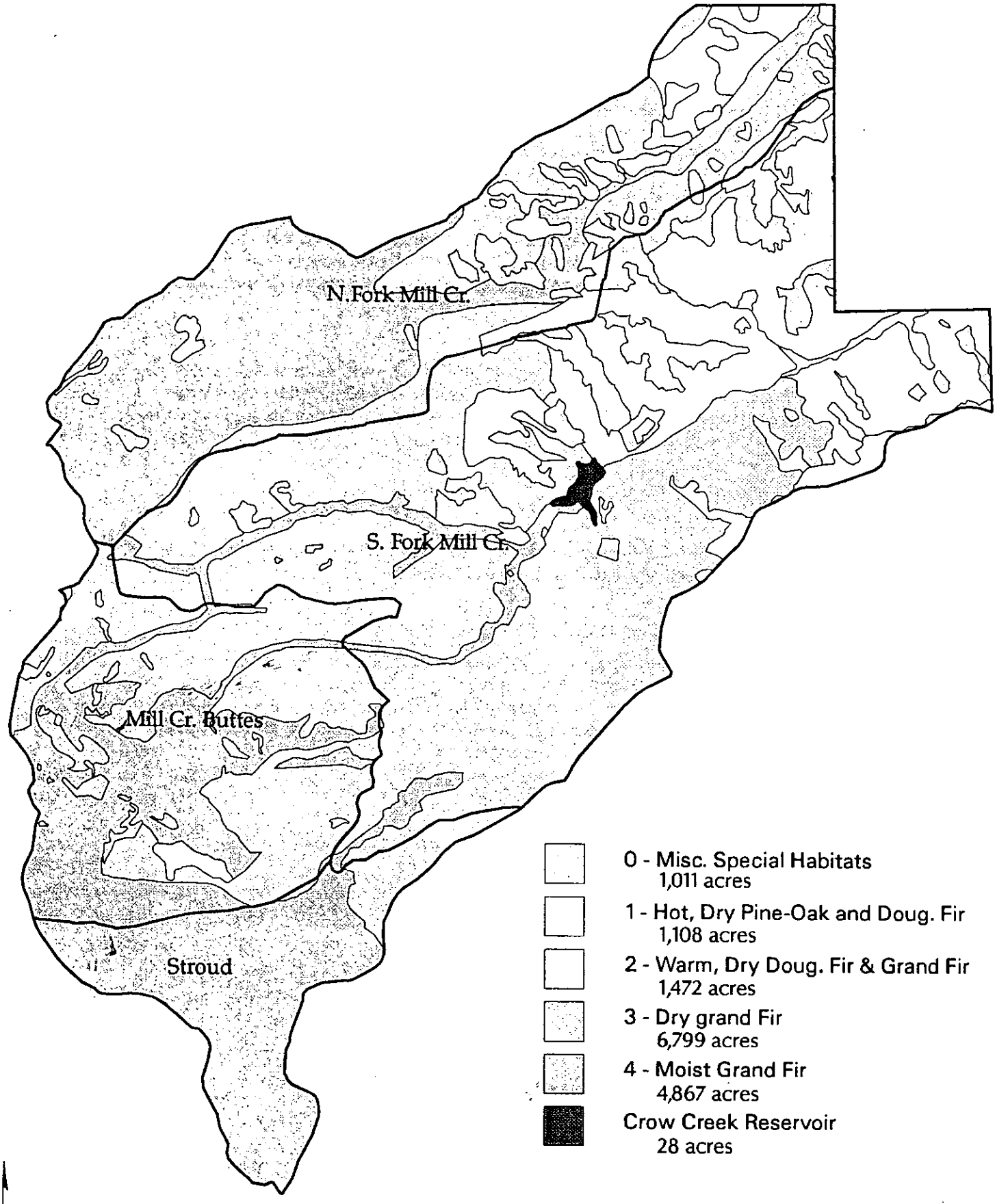


Figure 2-4

Mill Creek Watershed Forest Zone



Vegetation - Forest Zones (see Figure 2-4)

North Fork and South Fork Landscape Units

The western, upper elevation portions of these landscape units is dominated by moist-site (more common in the North Fork) and dry (most prevalent in the South Fork) grand fir zone forests in various stages of succession. Much of the upper area has been harvested, by both shelterwood and clearcutting. These areas have early seral stands dominated by Douglas-fir, with lesser amounts of Ponderosa pine, grand fir, and lodgepole pine. Multi-story mid- and late-seral stands of Ponderosa pine and Douglas-fir, with an understory of shade-tolerant grand fir, dominate the balance of these landscape units. Western larch, lodgepole pine and western white pine may also be present. The structure and composition of these stands is strongly influenced by fire exclusion, which results in denser, smaller diameter stands and a greater preponderance of grand fir than would have been the case under a natural fire regime. In the lower, eastern portion of the landscape unit, these forests are extensively interspersed with rocky openings dominated by oak woodlands and grassy areas.

Mill Creek Buttes Landscape Unit

The area that surrounds Mill Creek Buttes primarily has late- and mid-seral forests in the moist and dry grand fir types. The western portion is moister and has older, very diverse forests, dominated by Pacific silver fir, Engelmann spruce, western white pine, western larch, Douglas-fir, grand fir, western hemlock, western redcedar and lodgepole pine. The forests of the eastern slopes are primarily a mix of Douglas-fir and ponderosa pine with an understory layer of grand fir, a result of fire exclusion.

Stroud Landscape Unit

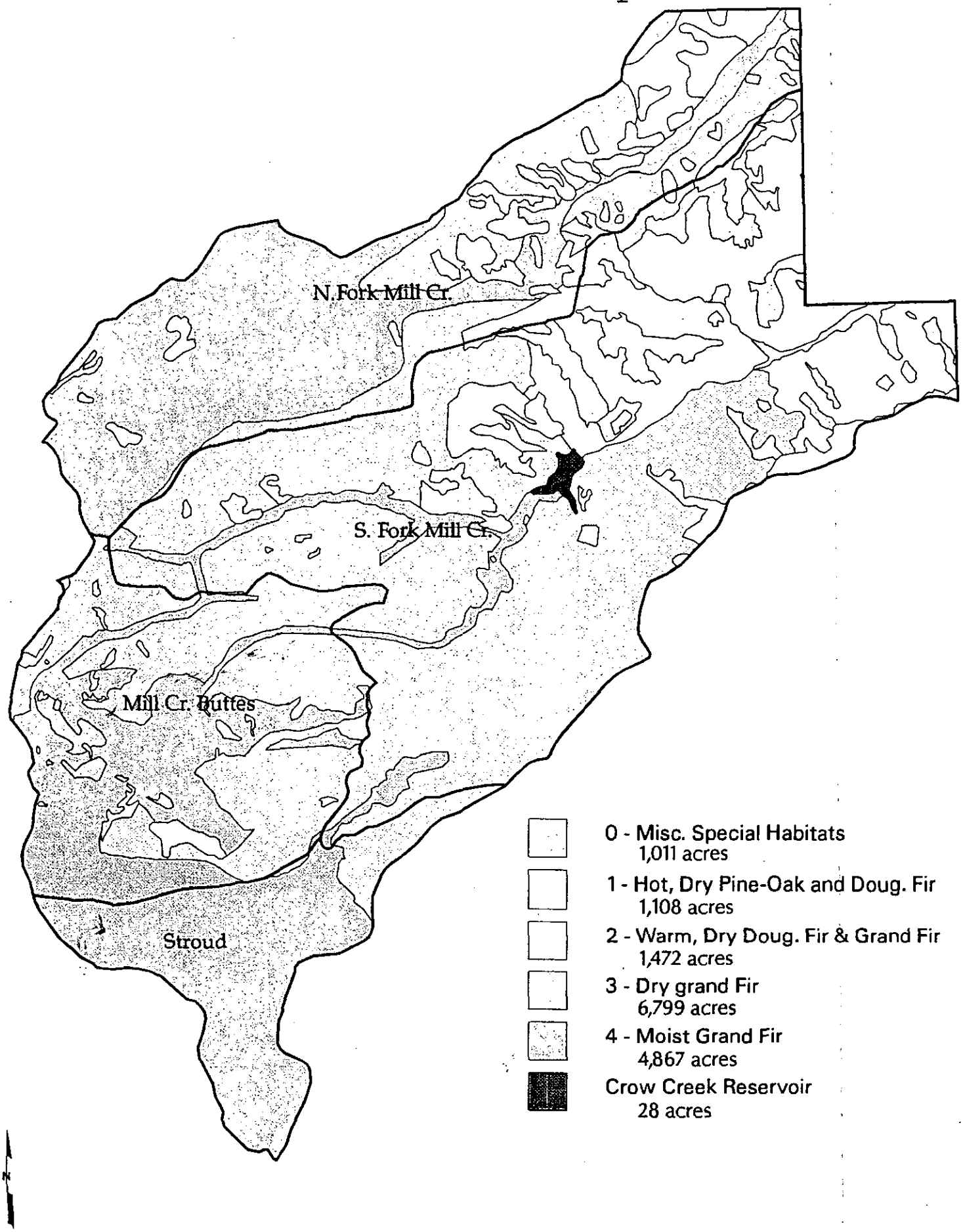
This landscape unit consists mainly of late- and mid-seral stands very similar in species composition to those of the Mill Creek Buttes Landscape Unit, interspersed with early successional clearcuts.

Rural and The Dalles Landscape Units

The vegetation of this landscape unit has been significantly affected by agriculture, housing development and urbanization. While remnants of the natural vegetation - oak woodlands, grassy openings, willow-graminoid and hardwood wetlands, and scattered Ponderosa pine - are found, much of area consists of orchards, pastures, building sites, parking lots, parks and other landscaped areas, and grazed areas with exotic grass and forb species. The vegetation of these landscape units is actually very diverse, owing to the large numbers of exotic species.

Figure 2-5

Mill Creek Watershed Fire Group



Fire

1900-Present. Some records exist of fire history for Mill Creek Watershed, although records are scattered and difficult to locate. Presented here is what information we were able to find.

Shortly after formation of the National Forests in 1906, effective fire control began. A 1939 letter from the Dufur District Ranger boasts of the generally successful nature of the fire control efforts and the resulting increase in conifer regeneration. Associated documents from this time period also discuss the loss of grazing lands due to tree regeneration.

Early diary entries for Forest Service personnel mention fighting fires in the area. Guard camps or lookouts were mentioned for several places along Surveyors Ridge. Camps were probably established in high meadow areas since they provided pasturage for the horses and mules. No large fires are known to have burned in this time period.

Fire occurrence records along with information of fire regimes and fuel loadings, are used to evaluate the existing fire risk.

Fire Regimes

Fire Ecology Groups, or Fire Groups, have been developed for the Mt. Hood National Forest (Evers et al., 1996) (see figure 2-5). The mapped Fire Groups depict the fire ecology and regimes of the Mill Creek Watershed based on plant associations and typical pre-1855 conditions . (See map)

Fire Group Zero: Miscellaneous Special Forest Habitats. This Fire Group consists of areas that are not coniferous forest within a forest matrix. Most examples of Fire Group Zero consist of rock outcrops and scree (or talus), forested rock, and wet and dry meadows. Patches of Fire Group Zero burn at highly irregular intervals and generally with a return frequency similar to the surrounding fire group. Fire Group Zero occurs throughout the watershed, generally in small patches. Some areas are large enough to serve as fuel breaks for low and moderate intensity fires, but rarely are large enough to slow or stop high intensity fires.

Fire Group One: Hot, Dry Pine-Oak and Douglas-fir. Fire Group One mostly lies on steeper south and southwest aspects, like those found in the South and North Forks of Mill Creek. Fire Group One typically underburned frequently with an estimated return interval of 5-10 years.

Fire Group Two: Warm, Dry Douglas-fir and Grand Fir. Fire Group Two can be found primarily in the South and North forks of Mill Creek near the Forest Boundary, and likely for a ways east of the boundary. A small patch also exist on the south slope of Mill Creek Buttes in the Mill Creek Buttes LU. Underburning was the typical landscape level event in Fire Group Two with an estimated return interval of about 15-25 years.

Fire Group Three: Dry Grand Fir. Fire Group Three covers the largest area in the Mill Creek Watershed within the Forest boundary. Fire Group Three frequently underburned, but occasionally experienced stand-replacing fire. The fire return was highly variable, probably averaging around 30-60 years but with an estimated range of 15-100 years between events.

Fire Group Four: Moist Grand Fir. Fire Group Four occurs mostly along the west end of the watershed, in the higher elevations and in riparian areas like Alder, Crow, and South and North Forks of Mill Creek. On the North Fork, in the riparian zone, this group extends all the way to the Forest boundary and may extend for some distance beyond that. Most landscape level fires were stand-replacing through crown fire and lethal underburning, with some non lethal underburning around stand edges and in drier associations within the Group. The average return interval was probably between 150-300 years.

Even through Fire Group Four typically burns in stand replacing fires that cover several hundred to several thousand acres, lower intensity fires can occur between these events. Low intensity fires typically burn only a single tree or a very small patch. These events create snags and downed wood, but the fire occurrence rate is so low that the other agents, such as insects and disease, are more important providers of these habitat elements.

Moderate intensity fires involve a mix of stand-replacing fire and a limited amount of underburning. These fires can occur in younger stands that contain relatively low fuel loadings. Moderate intensity fires depend on the presence of "jackpots" of heavier fuel loadings in an otherwise lightly loaded area, at least a moderate lichen load in the overstory, and moderate to high winds (generally greater than 10 m.p.h.). Wind is needed in increase fire intensity and the lichens serve as a fuel ladder in the tree crowns. The fire spreads primarily by crowning through the needles and lichens and some short-range spotting. In the absence of wind, fire may spread slowly through what surface downed woody material exists and along older rotten logs. The pattern produced in the understory is one of small burned out patches and linear burnt out stripes (cigarette" burns) where logs are consumed. The duff is usually too densely packed and just moist enough to not burn well away from the jackpots and dry logs. Moderate intensity burns cannot occur every year but can occur in many years. These fires usually burn between 50-300 acres. When the winds die down, these fires also die down and usually will not "kick up" again in the absence of another wind event.

Existing Fire Risk

Rating the existing risk for large stand-replacing fires involves two separate elements. In fire management, the term "risk" specifically refers to the probability that a fire will start and spread. Risk is often expressed as an occurrence rate, or the average number of fires per 1000 acres per year. An area of low risk means the area typically experiences few starts during the declared fire season (June 15th through October 15th). The term "hazard" specifically refers to the available fuel loading. Due to curing and seasonal drought, the hazard rating of a given area changes throughout the declared fire season. An area of high hazard means the area has a large amount of available fuel at the time of the rating. The hazard ratings, as listed under the section on fuel loading, are for the hottest and driest part of the fire season, typically ranging from mid-July through mid-September in this watershed.

Fire Occurrence Rates. Fire occurrence rates are very low for the entire area, generally 0.097 fires per 1000 acres per year, based on data from 1970-1990. No areas of concentrated starts occurred within the watershed. Fires rarely occur in multiple starts (busts). Arson has not been a problem. Storms that form on the south side of Mt. Hood or over the Cloud Cap area typically result in lightning on Surveyor's Ridge. Lightning busts are possible, but rare. The last major bust was recorded in 1961. A similar event today would likely result in at least one escaped fire due to the reduction in both initial attack personnel and reinforcements within all wildland fire fighting agencies in the area. Most human caused fires have remained small.

Fuel Loadings. We have not used Browns method for inventorying downed woody material to estimate natural fuel loadings. This discussion is based on observations of current conditions and is qualitative. Due to the lack of complete data, areas of low, moderate, and high fuel loading have not been mapped. The discussion is by Fire Group. Fine fuels are woody material less than 3 inches in diameter, ponderosa pine needles, and grass.

Loadings in Fire Group One are generally low on the open slopes of North and South Forks of Mill Creek, and where they might occur elsewhere in the watershed. Loadings in Group Two are generally moderate to borderline high in terms of downed woody material. Ladder fuels are fairly extensive and probably outside the range of natural conditions, particularly in draws and along intermittent streams. Fire Group Two would normally carry moderate loading in the form of cured grass by late June and early July. Due to increased tree density, the grass load has declined. Loadings in Fire Group Three are high along Surveyors Ridge, which cover Stroud, Mill Creek Buttes, and smaller parts of the North and South Forks Landscape Units. The loadings are moderate to high elsewhere. Ladder fuels are very extensive and we believe they are outside the range of natural conditions. Dwarf mistletoe is a significant factor in increasing both downed woody loadings and ladder fuels. Recent spruce budworm, fir engraver, and root disease problems are also causing rapid increases in downed woody loadings. Windstorms have added to the fuel loadings by uprooting trees affected by root disease and snapping other trees. Since fuel accumulation rates far exceed decay rates, fine fuel loadings are starting to become a concern, particularly on Surveyors Ridge.

Loadings in Fire Group Four are high along the 17 road and more moderate further east of the road. As in Group Three, recent spruce budworm, fir engraver, root disease activity, and windstorms are causing rapid increases in downed woody loadings in all size classes.

Expected Fire Intensity and Severity. Fire intensity in this discussion (referenced from the fireline handbook) refers to flame lengths. Fire severity refers to duff and downed log consumption. Before 1855 (the start of European

settlement in the area, and based on our records and knowledge of the area), both fire intensity and severity were low in Fire Groups One, Two, and Three. These areas mostly underburned with low flame lengths. Fires were generally frequent enough to limit duff buildup and downed log numbers. Frequent fire was a main factor in creating and maintaining the characteristic old growth structures in these areas Open Parklike in Fire Groups One and Two, Cathedral in Fire Group Three. Since the average fire return interval was more variable in Group Three, occasionally the fuel complex would support moderate and high intensity fires and moderate severity fires. Fire return was probably frequent enough to limit high severity fire to very small spots that are insignificant even at the stand level.

Current conditions will support high intensity and severity fires in Fire Groups Two and Three. Such fires would eliminate any existing late successional and old growth stands and the potential to move existing stands towards the characteristic old growth structure quickly. On steeper slopes, as in the North and South forks of Mill Creek near the Forest boundary, and east towards The Dalles, such a burn would be much more susceptible to erosion due to the near total loss of protective cover. A high intensity rainstorm before a new vegetative cover established might result in a change in site capability, under the worst case conditions. In addition, since the various organisms typical of these Fire Groups are not adapted to high intensity or severity fires, we could see significant reductions in soil arthropods and fungi, particularly mycorrhizal fungi.

Fire Group Four typically experienced a wider range of fire intensities and severities than the drier fire groups, although high intensity fires are the most significant at the landscape level. Fire severity would also be highly variable within an individual burn. Successive reburns often result in high severity fires as cumulative effect. Most organisms within these fire groups are adapted in some manner to high intensity and high severity fires. We do not believe that the fire regime and expected intensities and severities have changed significantly from what was characteristic before 1855.

Much of the area within Group Four is relatively old and carries the fuel complex needed to support development of high intensity fire. The largest high intensity fires typically burn under conditions of extreme drought, low relative humidity, high temperature, and high winds. Mill Creek Watershed western edge, does not need as severe a drought to provide suitable conditions for a large fire. Research in Yellowstone National Park after the 1988 fire season found that stand structure stage and fuel complex are largely irrelevant under extreme conditions (Turner and Romme 1994). Essentially everything will burn until the weather changes (winds die down, temperature drops, humidities rise, or significant precipitation falls).

Large Stand Replacement Fire Risk

The risk rating in this section attempts to integrate the specific meaning of risk (probability of a fire) with the hazard (available fuel) for the area under discussion. It attempts to integrate any changes in expected fire intensity and behavior brought on by nearly 100 years of fire exclusion and the various timber management practices. Lastly, the risk rating reflect a subjective judgment on the impacts of a large stand-replacing fire on available mid and late-successional and old growth habitat, the potential to provide such habitat over the next 20 years, and the potential impacts on site quality.

Fire Groups Three and Four. Overall stand-replacing fire risk is high within the watershed. Over 50% of the forested area within the National Forest boundary is in these two groups. Clearcuts and shelterwoods break fuel continuity in Fire Group Four. However, in-growth of shade tolerant species and widespread insect and disease related mortality in the surrounding stands has increased fuel loadings and ladder fuels. Most of Fire Group Four lies within The Dalles Watershed. The current Memorandum of Understanding (MOU) limits the amount of harvesting and prohibits broadcast burning as a fuel treatment. Most units have been hand piled or machine piled and burned. Piling slash does not reduce the fine fuel loading as well as broadcast burning, such that some units still contain the potential to contribute to fire spread and intensity.

Most of Fire Group Three lies on the ridges down to the riparian zones in South Fork LU and to a lesser degree in the North Fork LU. These areas have limited road access either due to steep terrain or from being within The Dalles Watershed. In-growth of grand fir, widespread insect and disease related mortality, and strong winds (mostly upper ridge areas) have increased fuel ladders and fuel loadings. Surveyors Ridge is fully exposed to strong west winds

that sweep across the upper Hood River Valley. The ridge is a large topographic barrier to air flow, causing winds to accelerate as they "squeeze" over the ridge into Mill Creek watershed from upper Hood River Valley.

Lethal underburning may occur in areas where ponderosa pine is still a major stand component and the area has not burned for several decades. Ponderosa pine sheds a large number of bark plates each year. Through time, deep pedestals of bark plates and needles build up around the base of these trees. The pedestals can be over 4 inches deep around the larger trees. Fire can smolder for many hours to days in these pedestals, killing the cambium even through the thick bark present on the living boles. In addition, smaller diameter grand fir and Douglas-fir is fire sensitive such that even a fire that does not crown can kill the cambium of these thin-barked trees.

These Fire Groups provide the most heavily used northern spotted owl habitat at this time and has the potential to provide the highest quality late successional habitat in the moist grand fir series.

Recreation use is increasing throughout the watershed, however is at its highest during deer and elk hunting seasons. The fire hazard generally increases in the summer due to curing of grasses in both natural and created openings.

Fire Groups One and Two. These Fire Groups are generally located in portions of the South Fork and North Fork LUs from Crow Creek Dam to the east. Stand-replacing fire is a low to moderate risk. However, the areas of Fire Group Two are relatively susceptible due to in-growth of fire sensitive species, ladder fuels, and higher than typical fuel loadings. Stand replacing fire in the intermittent streams and draws in the South and North forks could result in the lose of critical thermal and hiding cover on the otherwise open slopes. There is fairly limited access into these area due to few open roads and few maintained trails. Most use would be during spring and fall hunting seasons.

As the landscape moves towards the Desired Future Condition identified in this Watershed Analysis, the risk of stand-replacing fire should change in all zones. The risk should decrease in the lower elevations as stands become more open and dominated by fire resistant species.

Botany

We do not know how heavily Mill Creek watershed is utilized by Native Americans in gathering cultural plants however, we suspect, or strongly suspect, that the Native Americans are using this area for the gathering of cultural and medicinal plants. However since they are not required to report the locations or quantities removed, we have no way of knowing how much disturbance on the land is occurring due to this type of use.

In a 1988 Warm Springs Reservation (WSIR) report there are 56 plant species recognized as important to the tribes. The list of species was compiled under the guidance of the Warm Springs Culture and Heritage Committee. A list of these species are located in appendix D.

There are several threatened, endangered, and sensitive species within the watershed analysis area.

Attached is a table of R6 Sensitive Plants, and other species of concern, that are known or suspected to occur in the Mill Creek watersheds.

DEFINITIONS AND CRITERIA

The following are acronyms and ranking criteria used in the attached table:

USFS Regional Forest's List of Region 6 Sensitive plants, specific to the Mt. Hood National Forest (1994 list). Includes species on the Oregon Natural Heritage Data Base List (ONHDB) of Rare, Threatened, and Endangered Plants of Oregon .

(ONHDB) Oregon Natural Heritage Data Base, December 1995. Although many of the species on the ONHDB list are not included in the Regional Forester's List of Sensitive Plants, the USFS is encouraged to inventory for ONHDB species in order to keep track of population trends and threats to habitat.

List Categories:
1. Taxa that are threatened with extinction or presumed extinct throughout their entire range.

2. Taxa that are threatened with extirpation or presumed extirpated from the state of Oregon.

3. Species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.

4. Taxa which are of conservation concern, but are not currently threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered.

Table II-1 Liverworts, Mosses, Lichens-Documented (D) and suspected (S) to occur in Mill Creek watershed.

	SPECIES	USFS	ONHDB 95
S	*Ulota megalospora* (added in 1997)		3
S	*Lecanora pringlei*		3

Table II-2 Vascular Plants-documented (D) and suspected (S) to occur in Mill Creek watershed.

	SPECIES	USFS	ONHDB 95
S	*Agoseris elata*	R6 Sens.	2
S	*Allium campanulatum*		4
D	*Arabis furcata*		4
D	*Arabis sparsiflora var. atrorubens*	R6 Sens.	2
D	*Astragalus hoodianus*	R6 Sens.	2
S	*Botrychium minganense*	R6 Sens.	2
S	*Botrychium montanum*	R6 Sens.	2
S	*Botrychium pinnatum*	R6 Sens	2
S	*Calochortus longebarbatus var. longebarbatus*	R6 Sens.	1
S	*Chaenactis nevii*		4
S	*Cypripedium montanum*		4
S	*Diphasiastrum complanatum*	R6 Sens.	2
S	*Hackellia diffusa var. cottoni*		4
D	*Lomatium watsonii*	R6 Sens.	2
S	*Lycopodium annotinum*		4
S	*Meconella oregana*	R6 Sens.	1
S	*Penstemon barrettiae*	R6 Sens.	1
D	*Ranunculus reconditus*	R6 Sens.	1
S	*Suskdorfia violacea*	R6 Sens.	2

SUMMARY - R6 Sensitive Plants - Management and Restoration
There are four R6 Sensitive Plants that are have been documented in the Mill Creek watershed: *Arabis sparsiflora* var. *atrorubens* (sickle-pod rockcress), *Ranunculus reconditus* (The Dalles Mt. Buttercup), *Astragalus hoodianus* (Hood River milk-vetch), and *Lomatium watsonii* (Watson's desert-parsley).

Hood River milk-vetch is known from two locations in this watershed, one historical with no location given and the other on private land within the Columbia Gorge National Scenic Area (CGNSA).

Watson's desert-parsley, was found on a BLM parcel on Mill Creek Ridge.

The Dalles Mt. Buttercup grows on Mill Creek Ridge on a parcel owned by The Nature Conservancy and at present does not seem to be threatened. A second population is located on private ground.

Sickle-pod rockcress grows along Surveyor's Ridge. It is the only sensitive plant species within the forest boundary in this watershed. Some of the populations straddle the boundary between the Barlow and Hood River Ranger Districts along surveyors ridge. The following impacts are currently affecting this species:
Impacts and Potential Restoration - Surveyor's Ridge:

Noxious weeds Knapweed is encroaching on habitats in open grassy meadows and gravelly slopes along Surveyor's Ridge.

Recreation There is evidence of off road compaction, soil displacement, and vegetation damage.

Cattle There is evidence of manure concentrations and trampling in sensitive plant habitat along Surveyor's Ridge.

Sensitive species.

Arabis sparsiflora var. *atrorubens* : Sicklepod rockcress is uncommon but is found on both Barlow and Hood River districts, on dry , rocky openings on ridgetops and slopes in pine/oak/Douglas-fir stands at 2,800 to 4,200 ft. elevation. It seems to be more common near brush probably because it is somewhat protected from grazing by large herbivores since it also does well in more open situations if not grazed. All populations are on the north end of the districts with the majority of the populations found in Mill Creek, Fivemile and East Fork Hood River watersheds, especially along Mill Creek Ridge and Surveyors Ridge. It is a Region 6 sensitve species and Oregon Heritage Program list 2 (rare in the state but more common elsewhere). Current conditions seem good but there is some threat from habitat invasion by knapweed and cheatgrass. Along Surveyor's Ridge off road vehicles use has created some tracks that have reduced habitat. Early grazing ,prior to seed dispersal, will reduce seeding and new plant recruitment (it is a biennial or weak perinnial so it must continue to produce new plants to maintain its existence) There is some cattle grazing in the area. Road obliteration and ripping increased the number of plants in the Fivemile Watreshed. Apparently some disturbance helps maintain or increase the plant population. Road ripping and fire would likely benefit the population. The first observation listed for this plant in the Oregon Heritage Program database for this area is 1982 so there is no record of historical abundance.

Astragulus hoodianus : Hoodriver milk-vetch is an uncommon endemic found only in Oregon and Washington near the Coumbia River Gorge near The Dalles, Lyle and Mosier. . Lower Mill Creek seems to be about the center of the range. All of the known sites are off the forest at lower elevations. The Oregon Natural Heritage Program lists it as secure and not rare throughout its range but rare, threatened or uncommon in Oregon. The most likely threats are grazing, farming and development. The plant is a palatable periennial that can withstand some grazing if allowed to set and disperse seed. The earliest reported sightings are circa 1917 and some sites have not been relocated. The total population has certainly been reduced from historic levels since much of its range is in areas suitable for farms, orchards, and both urban and rural development.

Lomatium watsonii : Watson's desert parsley is considered globally secure but rare within the state. Two small populations were found recently on Mill Creek ridge on BLM land near the forest boundary. It is some what threatened by

off road motor vehicles using the open grassy areas that are its habitat. If the road access remains in poor condition or is closed these populations will probably remain stable but if off road use increases, particularly early in the season, there will likely be a decline. Since the sites were recently discovered there is no sound basis to determine historical abundance however the sites have not had much disturbance and are rather remote so it is likely the population is about as abundant as it ever was in this local.

Ranunculus reconditus : The Dalles Mtn. buttercup is listed as a G-2 (rare through out its range) and critically imperiled in Oregon. It is listed as list 1 (endangered or threatened throughout its range) in the Oregon Natural Heritage Program and listed endangered by the state of Oregon. The Oregon Natural Heritage Program lists three sites in Oregon, two are still existing. Both are in the North Fork Mill Creek subwatershed, one in the Mill Creek Preserve on Mill Creek ridge and the other is on private land. The Mill Creek ridge site was visited in the spring of 1997 and was in good condition with no obvious threats. Both existing sites are associated with basalt rock outcrops in grassy dry sites. The first site reported in Oregon was last seen in 1895 and is just outside of this watershed. The sites in this watershed were first reported in 1985 and 1987 so there is no historical record for this area. It is likely that the species is less abundant now since it occurs where grazing was common.

Survey and manage species from the Record of Decision for the Northwest Forest Plan.

There are no known vascular plants, fungi or bryophytes with management implications from the Record of Decision known to occur in the Mill Creek Watershed at present. There are several species that could potentially be found here. A list of those species that may be found in this watershed and which have management implications (strategies 1 or 2) are found in (Appendix E). There are four components or strategies for the species as listed in table C-3 of the ROD.

Survey Strategy 1 - Manage known sites : This may mean complete protection or simply considering the species when planning actions, based on current information. There is still some question as to whether these species have to be dealt with if they are discovered after an activity is initiated such as the TE&S species are. Current advise is that there will be direction to manage sites as soon as they become known even after an activity is initiated. Management guides are being developed by the Regional Ecosystem Office but as of April 1997 only the draft management guide for bryophytes has been distributed.

Survey Strategy 2 - Survey prior to ground disturbing activities. The Regional Ecosystem Office is responsible to develop protocols for conducting these surveys which must be completed prior to ground disturbing activities implemented in F.Y. 99 or later. We have very minimal information on most of these species that might be found in the Mill Creek Watershed. However we based on the habitats where these species have been found.

Survey Strategy 3 - Extensive surveys : Conduct extensive surveys for the species to find high-priority sites for species management. Surveys are not required prior to conducting ground disturbing activities. Responsiblility for these surveys is at the regional and forest level. The ROD states that these surveys are to be underway by 1996 but no survey protocls have been distributed as yet and no formal surveys have been conducted in this area. The important point here is that these surveys are not required before any activities, however many of these are strategy 1 species which, if found, must be managed.

Survey Strategy 4 - General regional surveys : Survey for species to acquire additional information and to determine necessary levels of protection. Currently the responsibility to conduct these surveys has been assumed by the region. They are to be initiated by FY 1996 and be done in 10 years. As of November of 1999, protocals have been established for the majority of the C3 species, but few surveys have been conducted to date.

Table II-3 Survey strategy 2 species suspected to occur in the Mill Creek Watershed.

Species	Growth form	Strategy
Oxyporus nobilissimus	fungus, polypore	1, 2, 3
Bondarzewia montana	fungus, polypore	1, 2, 3
Hypogymnia duplicata	lichen	1, 2, 3
Tritomaria expectiformis	liverwort	1, 2
Ulota megalospora	moss	1, 2
Allotropa virgata	candystick, vascular plant	1, 2
Botrychium minganense	gray moonwort, grape-fern	1,2 & R6 sensitive
Botrychium montanum	mountain grape-fern	1,2 & R6 sensitive

Survey and Manage plant surveys for component 2 species must proceed the design of all ground-disturbing activities implemented in 1999 or later (this includes most of the protection buffer species listed on pages C-20 and C-27 of the ROD). Surveys for component 3 species (extensive surveys to find high priority sites for species management) are to be underway by 1996 but **are not** required prior to ground-disturbing-activities. Component 4 surveys (reneral regional surveys) are to acquire additional information and to determine necessary levels of protection. There is no mention of surveys prior to ground disturbing activities. Only species which include strategies 1 or 2 have been included as they are the only ones that have management implications at present. There are a large number of strategy 3 species listed because they are also listed as strategy 1. This appendix should not be used exclusively to determine whether or not a species has potential to occur in the Mill Creekwatershed or on the Mt. Hood National Forest. (See Appendix F for additional Information) Appendix F includes a list of Survey and Manage species suspected to occur in the East Fork and Middle Forks of Hood River thou several are suspected to occur in Mill Creek as well and they are indicated on the list.

Noxious Weeds

The following weeds are present or suspected in the Mill Creek Watershed and are on the Oregon State list of noxious weeds:

1. Bull thistle
2. Canada thistle
3. Diffuse knapweed (which includes spotted and meadow knapweeds)
4. Houndstongue
5. Quackgrass
6. Rush skeleton weed
7. Scotchbroom
8. St. Johnswort
9. Tansy ragwort
10. Yellowstar thistle

Many of these weeds are found along roadsides and can be spread by vehicles, especially knapweeds which often lodge underneath vehicles. The disturbed road shoulders are commonly dominated by invasive weeds that can spread into the surrounding environment.

The current situation in Mill Creek Watershed is low to moderate on the Forest Service portion of North Fork Mill Creek in the Gibson Prairie portion of the Long Prairie Allotment. The noxious weed numbers are down here from historic levels when grazing was much higher and at fairly regular intervals. The South Fork Mill Creek noxious weed numbers are very low within the Forest Service Boundary.

Noxious Weeds can reduce plant community's capability to produce forest products such as herbs, mushrooms, and wood by out-competing native plants. These plants have been proven to hoard nutrients and moisture, secrete

allelopathic substances, produce vast amounts of seeds, spread vegetatively, and create generally unfavorable conditions for the growth of other plants (see Appendix G).

Wildlife

Mature Habitat Species: (spotted owls, flying squirrels, goshawks, etc.)

The majority of the mature habitat (8678 acres or 62 percent of the land within the national forest boundary) lies generally within the riparian areas and north aspects.

Spruce budworm infestations have caused tree mortality within the mature habitat. The past mortality (< 5% of the watershed) is mainly in patches with some scattered individual tree mortality. The severe budworm attacks seem to coincide with drought cycles. We are currently in a wet cycle.

Timber harvest has fragmented the mature habitat and affected the amount of interior habitat (2600 acres or 18 percent of the lands on national forest) available for those species associated with interior habitat.

The Mill Creek Butte LU (landscape Unit) appears to be the hub (Surveyor's Ridge LSR Assessment, 1997) for mature habitat. It is the head waters for several riparian areas and is the connecting habitat for north/south dispersal of mature species.

The landscape units east of the national forest boundary contain very little mature habitat. The habitat which does exist is mainly within the riparian areas and a few north aspect slopes.

There are currently five spotted owl activity centers within the watershed. This number of activity centers seems to be stable over the last ten years. There are no recorded great gray owl sites within the atershed. Some potential habitat exists within the watershed, mainly near the forest boundary.

Big Game Habitat: (deer, elk, bear, cougars, lynx)

Currently, the deer and elk populations are relatively stable within the watershed (ODFW, Keith Kohl). The Dalles Municipal Watershed (controlled access) acts as a security area for deer and elk. This security area attracts deer and elk which has led to some damage complaints on private lands adjacent to the Watershed boundary. The Dalles Watershed currently has a limited entry hunt (25 tags each) for archery elk and rifle elk.

The majority of the deer and elk winter range is on private land within the watershed analysis area. This contributes to increased damage complaints especially during severe winters.

The black bear and cougar populations are increasing throughout the watershed. This is mainly due to the ban on hunting these species with dogs. Damage complaints (mainly killing pets and livestock) have increased annually since the ban went into effect in the early 90's.

Lynx habitat is associated with high elevation (generally above 4500 feet) early successional habitat. Some of this type habitat does exist in the far western portion of the watershed. Snowshoe hares are the main food source for lynx, thus hare habitat becomes the most critical element of lynx habitat.

Riparian Species: (beavers, raccoons, cope's giant salamanders, etc.)

The majority of the riparian areas within the Forest Service boundary are generally in good condition (good shading, adequate large woody material, good filter strips for sediment removal. A Cope's giant salamander was found in Crow Creek. This species is generally associated with clear, cold and fast moving streams (good water quality). The riparian areas below the National Forest boundary have been impacted by human development (mainly houses, pastures and agricultural development). This development has altered the use of the riparian areas by some animals such as the beaver. Fewer beavers are found on private lands and more racoons are present. People trapped the

beavers, removed beaver dams so flooding would not occur and channelized the stream to protect investments such as houses.

Raccoons prosper in the presence of humans. They like the garbage and food that people dispose. Other animals such as the opossum has appeared within the last 20 years. It is not specifically a riparian species but more associated with human development. It will compete with the raccoon.

Snag Dependent Species: (woodpeckers, nuthatches, bats, flying squirrels, etc.)

The majority of the conifer snag habitat occurs on the national forest land, the City of The Dalles land and private timber lands. The snag levels in harvested units are generally at the 60 percent biological potential. None of the clearcut harvest units (626 acres or 4 percent of the national forest land) have large green tree replacements for future snags within the unit boundaries. Any future timber harvest on the areas adjacent to these clearcuts will need to be analyzed for future snag needs. The snag levels in mature stands, with signs of insects and disease are generally at the 100 percent biological potential. Some snag habitat exists within the oak woodlands (700 acres or 4 percent of the land within the national forest). The oak trees very seldom grow large enough to support cavities.

The protection buffer species (ROD) such as the white-headed woodpecker and pygmy nuthatch require ponderosa pine snags. There is some pine habitat. Some pine habitat exists within the Mill Creek Buttes (LU), South Fork Mill Creek LU, and the North Fork Mill Creek LU. Fire exclusion and the selective harvest of large ponderosa pine trees have had the most impact on the species which use that habitat. The wildlife populations are stable to declining because of the changes in habitat.

Oak Habitat Species: (lewis's woodpecker, western gray squirrel, wild turkeys, etc.)

The oak woodland and pine/oak habitat (5 percent of the national forest lands) can be found in the following LUs': The Dalles, Rural, eastern portions of North and South Fork Mill Creek. This habitat type falls within the winter range area for deer and elk.

Within the last 100 years, fire has been excluded from this habitat. The effects of fire exclusion are unknown at this time. The single largest impact to this habitat has been human development. Agricultural development (such as orchards, tilled ground and grazing) and private/commercial development (such as houses and businesses) have impacted the Rural and The Dalles LUs' the most. Some human development has occurred on the eastern portions of the North and South Fork Mill Creek LUs'.

The wild turkey (introduced in the late 60s') population seems to be stable (ODFW, Jim Torland). They feed on the mast (acorns and seeds) and nest in logging slash and brush. The western gray squirrels seem to reside mainly in the pine/oak habitat. They use young pine trees to nest in (Susan Foster, 1992 phd thesis). The gray squirrel populations seem to fluctuate. This may be caused by weather, food supply and/or hunting. The lewis's woodpecker populations seems to be stable (Rich Thurman, personnal observations).

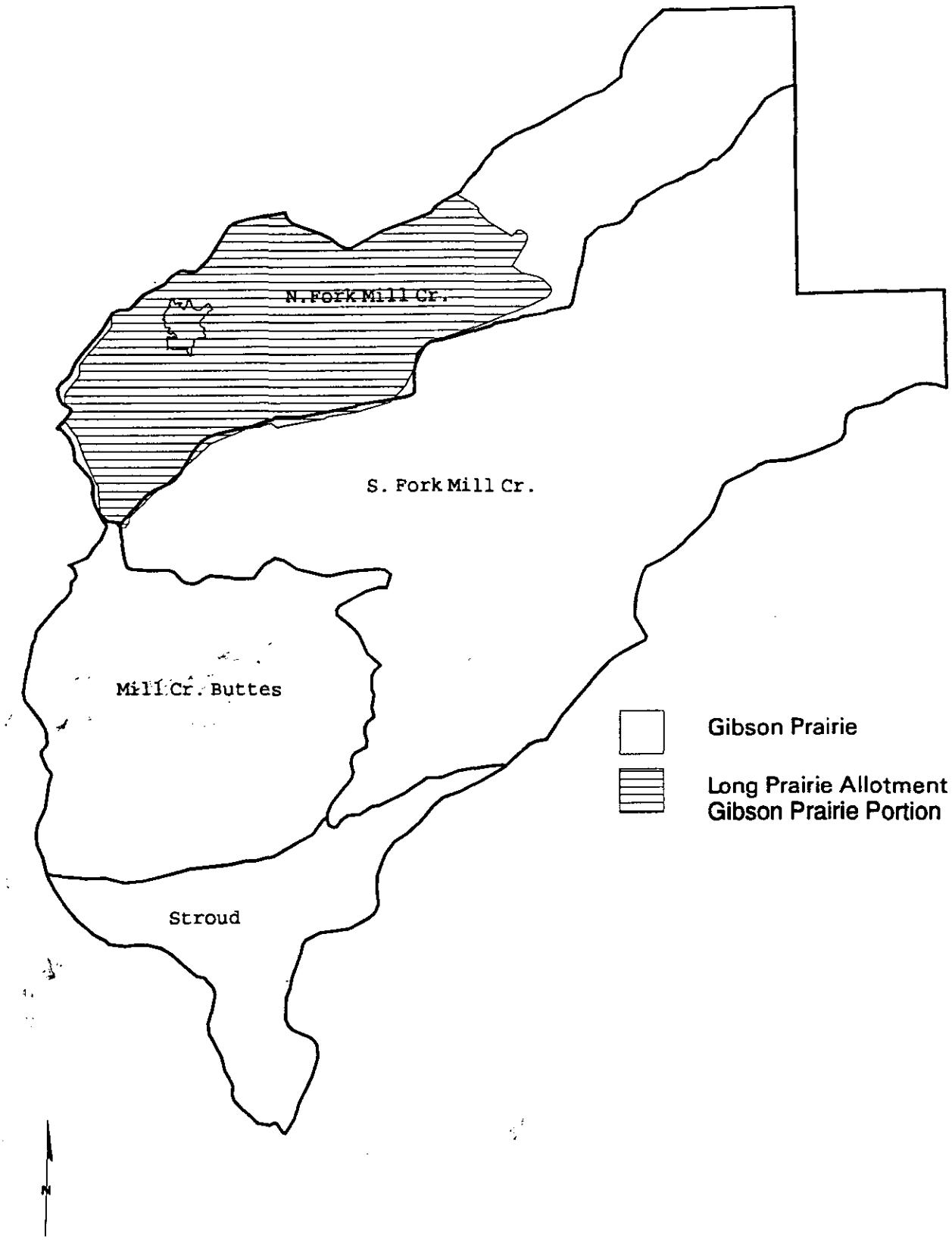
Range

Gibson Prairie is a portion of the Long Prairie range allotment lieing within the Mill Creek Watershed Analysis area (see figure 2-6). This allotment has been grazed since 1906. Since implementation of the Mt. Hood National Forest Land and Resource Management Plan (1990) two short term monitoring sites (utilization studies) were established within the area of this allotment. The annual operating plan identifies a "three pasture, rest-rotation" grazing system. This essentially has one of three pastures being completely rested once every three years. Since 1990 stocking of cattle levels have dropped and one of two permittees has taken non-use in 4 out 8 years. There was also a land exchange that removed approximately 1200 acres from the overall land bas within the allotment. This in turn resulted in issuance of a Term Private Land Grazing Permit being issued for these permits.

There have been numerous range improvements that have been constructed within the allotment to allow an even distribution of animals, preventing resource damage. These include fencing, water developments, and grass seeding.

Figure 2-6

Mill Creek Watershed Range Allotment



It is noted also that there has been some significant alterations of the wetlands in the Gibson Prairie portion from seeding and water developments. (see Appendix H)

Insect and Diseases

A variety of native and exotic insects and diseases are found within the Mill Creek Watershed Analysis area. Those species which are capable of causing tree mortality or limiting tree growth to the extent of significantly altering stand conditions will be the focus of this discussion. The following species are included in this group: mountain pine beetle, Douglas-fir beetle, fir engraver, western spruce budworm, annosus, armillaria root disease, laminated root rot, and dwarf mistletoe in Douglas-fir, ponderosa pine, and western larch. (Table II-4)

Table II-4. Important insects and diseases in the Mill Creek Watershed by Forest Zone.

Insects & Diseases	Hot Dry Pine-Oak/ Doug-fir	Warm Dry Doug-fir/ Grand fir	Dry Grand Fir	Moist Grand fir
Douglas-fir beetle	X	X	X	X
Fir engraver[1]		X	X	X
Mountain pine beetle in lodgepole pine.				X
Mountain/western pine beetle in ponderosa pine	X	X	X	
Western spruce budworm[2]	X	X	X	X
Annosus root rot[3]	X	X	X	X
Armillaria[4]	X	X	X	X
Laminated root rot[5]	X	X	X	X
Douglas-fir dwarf mistletoe	X	X	X	X
Larch dwarf mistletoe				X
Lodgepole pine dwarf mistletoe				X
Ponderosa pine dwarf mistletoe	X	X	X	

Other species which cause noticeable effects, but whose effects are likely to have intermediate to low impact upon the current and future vegetative attributes of the watershed analysis area, include pine engraver, larch casebearer, balsam woolly adelgid, blackstain, and white pine blister rust. These species while capable of causing important stand level effects, do not generally operate at the intensity and scale of the aforementioned "important" group of insects and diseases.

[1]Primary hosts are grand fir, white fir, and Pacific silver fir.

[2]Primary hosts include Douglas-fir, grand fir, white fir, and Pacific silver fir.

[3]Highly susceptible hosts include: S-strain: grand fir, white fir, and subalpine fir; P-strain: ponderosa pine.

[4]Highly susceptible hosts include Douglas-fir, grand fir, white fir, and sapling pines.

[5]Highly susceptible hosts include Douglas fir, grand fir, white fir, mountain hemlock, and, to a somewhat lesser extent, Pacific silver fir.

Note: Larch casebearer, while occasionally causing conspicuous defoliation on western larch, has never caused significant mortality in the Mill Creek watershed, however was on the increase in 1997.

Patterns and intensities of insects and diseases are somewhat different in the analysis area now than in presettlement times, particularly in areas with a history of frequent fire events before Euro-American settlement. Insect and disease activity is largely a function of insect or pathogen presence, host abundance, stand conditions, landscape patterns, and weather events and patterns. The greatest changes affected by man since presettlement times which have influenced insect and disease disturbance patterns, have been the vegetative changes in stand conditions and landscape patterns brought about by fire exclusion and selective logging of large pines. Denser stands, an increase in shade-tolerant species in stands that historically were dominated by pine, smaller average tree diameters, and an increase in the number of canopy layers, are examples of such changes. These changes have increased the frequency, scale and intensity of many insect and disease disturbance patterns, while decreasing the activity of others. Insect activity during the past fifty years has tended to occur most frequently in the upper portion of the Mill Creek drainage, within the National Forest boundary.

Defoliators, drought and overstocking increase stand susceptability to Douglas-fir beetle infestation. These factors have led to significant Douglas-fir beetle activity in the upper portion of the watershed. The infestations have been exacerbated by wind and other causes of mortality, when abundant dead and broken host material exist. Beetles have been able to move into remaining live or dead fir trees in this area.

The trend for Douglas-fir beetle activity has probably increased somewhat over pre-settlement patterns within the watershed and outbreaks remain strongly associated with large-scale windthrow events.

Fir engraver outbreaks are associated with periods of drought and defoliator activity. The intensity and frequency of the activity is probably greater than in the past, due to the effects of overstocking on fire excluded sites, spread and intensification of root disease. Scattered, occasional fir engraver activity is highly correlated with root disease. During the peak year of 1970, a very large number of trees in an area covering Upper Crow Creek and Gibson Prairie, and over another area in the vicinity of Ketchum Ranch, were killed. Another large outbreak occurred in 1995 in the upper portion of the Mill Creek watershed.

The trend for the fir engraver activity is appears to be more widespread, due to the increase of shade-tolerant host species in mixed conifer forest resulting from fire exclusion. However outbreaks are probably no more frequent than presettlement time.

The mountain pine beetle has been historically associated with mature, dense, lodgepole stands, overcrowded second growth ponderosa pine stands, and large, older western white pine in mixed species stands.

Mountain pine beetle activity peaked sharply in 1994 and 1997 in this area, and continues to act as an agent of mortality in dense lodgepole pine stands in the Mill Creek watershed. The frequency and the scale of mountain pine beetle activity in lodgepole pine has probably increased over historical levels due to fire suppression. Mountain pine beetle has also increased in scale, intensity, and frequency in overstocked second growth ponderosa pine stands. This is due to the increase of stands of this type on the landscape since the early 1900's when widespread selection logging converted old growth ponderosa pine stands to second growth.

The western pine beetle is historically associated with mortality of large ponderosa of declining or low vigor. Western pine beetle activity in ponderosa pine (especially second growth) and in western white pine markedly increased in intensity throughout the analysis area during 1969-1972, and increased again in 1991-1992, especially in second growth ponderosa pine, following drought periods.

The western pine beetle has also been found attacking overcrowded second growth ponderosa pine stands in much the same manner as and sometimes in association with mountain pine beetle. The scale and intensity of western pine beetle activity has decreased in large-diameter pine, although the frequency of attack has probably increased in the remaining large trees, due to lowered vigor resulting from crowding in fire excluded stands, while in second growth pine, the scale, intensity, and frequency of western pine beetle have increased.

Little information is available regarding the historic frequency, intensity and duration of western spruce budworm outbreaks within the analysis area, but outbreaks probably occurred periodically throughout the host type. Budworm defoliation tends to kill the higher percentage of understory host trees than overstory host trees, due to budworm larval behavior and tree competition. Western spruce budworm defoliation did occur within the watershed in 1947-51, 1983-88, and in 1994. During the 1983 outbreak, which also coincided with a period of drought that affected most of eastern Oregon, budworm defoliation was recorded at some point in nearly all susceptible host types.

Fire suppression and selective logging of non-host species have increased the extent and improved the quality of available budworm host type in the eastern Cascades, resulting in outbreaks that are more widespread and perhaps more intense than in presettlement times. Understory mortality across the landscape is probably greater than in historic times, due to higher amounts and densities of budworm host species occupying the lower canopy layers.

Fires largely determined the extent and amount of dwarf mistletoes during presettlement times. The distribution of dwarf mistletoes throughout the analysis area was probably limited in extent and low in intensity in most stands. The spread of dwarf mistletoe is favored by abundant host, dense stocking, multistoried conditions, and fire exclusion, all of which are common current conditions in the analysis area. Dwarf mistletoe in general are currently widespread throughout the mixed conifer type, and severe dwarf mistletoe infections, especially in Douglas-fir and western larch, are common in many areas.

Dwarf mistletoe has likely increased in the analysis area since the advent of fire suppression in the early 1900's. For most species, infections have become more severe in unmanaged stands, especially where fire has been excluded. It is likely that dwarf mistletoe has intensified in partial cut stands where infected overstory trees were left over a susceptible host understory.

Root disease centers of armillaria, annosus root disease, and laminated root rot, are scattered throughout the analysis area. Extrapolation from CVS plot data would indicate that about 12 percent of the analysis area is affected by root disease levels high enough to diminish canopy cover.

Root diseases have probably intensified in the analysis area during the last 90 years, due to fire exclusion, which has resulted in increased occurrence and density of highly susceptible host species, regeneration of root disease centers with highly susceptible species, and widespread partial cutting. Partial cutting exacerbates root disease problems when trees are injured or their roots are compacted during logging operations on sites infected with armillaria root disease. Partial cutting also enhances the spread of annosus root disease to live residual tress by creating a scattered pattern of stumps with extensive root systems which are easily colonized by this root disease.

The first recorded mortality of white pine blister rust in Mill Creek watershed was in 1966. Subsequent to 1966, white pine mortality has been recorded in the analysis area during each decade to the present.

Insect and disease hazard analysis tables are found in Appendix I. This table should be used in conjunction with stand exams of the analysis area to prepare silvicultural prescriptions that treat individual stands and prevent further the future spread of the aforementioned insect and diseases.

Hydrology

The Mill Creek basin is one of the more stable on the Mt. Hood National Forest. Mill creek is a fifth field drainage (designation 1707010521) which flows in a northeasterly direction. Elevations range from 4913 feet at Mill Creek Butte to 94 feet at the confluence with the Columbia River. Approximately 20% of the drainage lies within the rain-on-snow elevation band. Within the National Forest boundary, roughly 13% of the area has been harvested in the last 30 years. Riparian areas are generally fair to good in the upper watershed and show a recovery trend. Riparian areas in the lower watershed have been permanetly altered due to development and agriculture and will probably remain in a somewhat degraded condition. Sediment input occurs primarily from road related failures and small debris torrents. The additional water piped into the South Fork from Dog River has probably increased bank erosion above Crow Creek Reservoir. The South Fork Mill Creek, one of 2 main tributaries in this system, is the source for the municipal water supply for the city of The Dalles. The city takes water samples several times a day monitoring tupidity

and temperature amongst other things. If a problem develops with the sample they increase the number of samples they take so as to pinpoint the source of the problem.

Inter-basin transfer, urbanization, agriculture, and timber harvest have all contributed to change in the hydrological processes. Dog River has been piped into the South Fork, a reservoir has been constructed on the South Fork, water is withdrawn from the Mill Creek system for both municipal use and irrigation, timber harvest, road building, and fire exclusion have changed forest canopy, and flood plain encroachment has occurred through orchard development, livestock grazing, and urban growth of the city of The Dalles.

The reservoir has a big impact on smaller peak flows and the urban area and residential development as well as the tunnel (covering 900 feet at the mouth of Mill Creek) in The Dalles further impacts the peak flows as well as their effects. Additionally, most of the drainage is outside the rain-on-snow elevation band. ARP (Aggragate Recovery Precentage) was not calculated for this drainage.

Fisheries

Compared with other watersheds within the eastern portion of the Mt. Hood National Forest, there has been relatively little information collected concerning fish populations, abundance, species distribution, and habitat quality and quantity within Mill Creek watershed. Most of the information available is associated with The Dalles Watershed land management and water quality. (Figure 2-7, is included here to show the distribution of the streams across the western portion of the watershed and for reference in this fisheries discussion.) The following discussion focuses on fish populations and habitat within the Mt. Hood National Forest although downstream areas are discussed when information was avialable.

The Mill Creek Watershed supports on of the easternmost runs of indigenous winter steelhead trout (*Oncorhynchus mykiss*) in the Columbia River Basin. This population of Steelhead is within the Mid-Columbia Evolutionary Significant Unit (ESU) and is listed as Threatened by the National Marine Fisheries Service (NMFS). The Mid-Columbia Steelhead were listed on March 18, 1999[1].

Species presence and distribution likely has not changed a great deal since pre-Euro-American settlement times although there have certainly been changes in relative abundance and migration patterns due to human activity. Steelhead trout were known to ascend Mill Creek and then South Fork Mill Creek up to Mill Creek Falls. There is a good possibility that steelhead used the North Fork Mill Creek as well but this has not been documented.

Resident rainbow trout (*O.mykiss*) and sculpin (*Cottus spp.*) were present in Mill Creek up to the falls in South Fork Mill Creek, and were likely in North Fork Mill Creek. Dace (*Rhinichthys spp.*) were found in Mill Creek just below the confluence of North and South Forks of Mill Creek in 1983 but not further upstream, suggesting they were present in the system historically, but their overall distribution is unknown. Cutthroat trout (*O. clarki*) were present in the South Fork Mill Creek above the falls, including Alder and Crow Creeks.

As mentioned earlier in this chapter a flume was constructed in the South Fork of Mill Creek subwatershed in the late 1880's to transport lumber from John's Mill to The Dalles. This flume was not screened so fish could have entered the flume and traveled downstream. The flume probably did not impact anadromous fish, as the inlet was above the falls, unless the outlet was situated so ascending adults could enter the flume instead of continuing upstream in Mill Creek.

Since the falls in the South Fork Mill Creek precluded anadromous and resident fish migration upstream the biggest human impact to the fish was the construction of Crow Creek Dam in 1967, which effectively isolated cutthroat populations above the dam from those between the dam and the falls (although downstream passage is possible when

[1]The necessary NEPA work will have to be completed for any future ground disturbing projects in the Mill Creek Watershed. This includes BA's, EA's, ect. If the effects determination in the BA is NLAA (may effect, not likely to adversely effect) or LAA (may effect, likely to adversely effect) then consultation proceedures with NMFS must be initiated. After consultation is completed, then NMFS must issue a Biological Opinion (BO). The whole consultation process up to the issuing of the BO can take up to 6 months. Once the BO is issued, then the project can proceed.

water is spilled over the dam). Using Crow Creek Reservoir to rear anadromous fish (presumably steelhead) was considered by state and federal agencies but the program was never implemented.

There was a problem with algae blooms in the reservoir which if left untreated, plugged filters at the Wicks Treatment Plant[1] and had the potential to cause offensive odors and tastes in city drinking water. To control the algae the city applied copper sulfate crystals both in the reservoir and South Fork Mill Creek. Dissolved copper can be toxic to fish, particularly salmonids, under certain water chemistry conditions. It appears there were negative impacts to aquatic fauna as a result to copper sulfate treatments, because fish populations sampling conducted by USDA Forest Service (USFS) personnel in 1982, and by Oregon Department of Fish and Wildlife (ODF&W) in 1983 yielded no fish in South Fork Mill Creek immediately below the dam and very few fish as far as four miles below the dam. Copper sulfate treatments were discontinued in 1984. Based on USFS stream surveys conducted in 1991, cutthroat trout recolonized South Fork Mill Creek in the four mile reach below the reservoir, however population size is unknown. Recovery of aquatic insects is assumed but no surveys have been conducted.

Steelhead trout are currently found in Mill Creek and South Fork Mill Creek downstream from the falls. They are suspected to occur in North Fork but has this not been documented (Steve Pribyl, ODFW, personnel communication). Water is diverted at Wicks Treatment Plant and piped to The Dalles, essentially dewatered reach between the treatment plant and the confluence of North and South Fork Mill Creek (about one mile) during most summers. Overall impacts to both resident and anadromous fish in this reach are unknown but any salmonid stranded in this reach during this time period is likely to perish. This dewatered section also is a migration barrier. Depending on the time of the year this section is dewatered there could be impacts to steelhead trout trying to move upstream to spawn. Resident rainbow trout, sculpin, and dace are also found in this same area of the watershed. Rainbow trout presence in North Fork Mill Creek is likely but not verified (Steve Pribyl, ODFW, personnel communication). Above the falls only cutthroat trout and sculpin are found. Sculpin were noted in South Fork Mill Creek and above the reservoir in 1983, but their upper limit of distribution in this stream, as well as presence or absence in Crow and Alder Creeks, is unknown. Mill Creek cutthroat were seen upstream from the reservoir approximately 3.0 miles. An aqueduct from Dog River in the Hood River watershed, carries an additional supply of water for the City of The Dalles. The aqueduct empties into the South Fork of Mill Creek, augmenting streamflows and possibly providing a travel corridor for cutthroat trout from Dog River to the Mill Creek Watershed. The aqueduct is not screened and removes virtually all of the water from Dog River at that point. Cutthroat trout do inhabit Dog River.

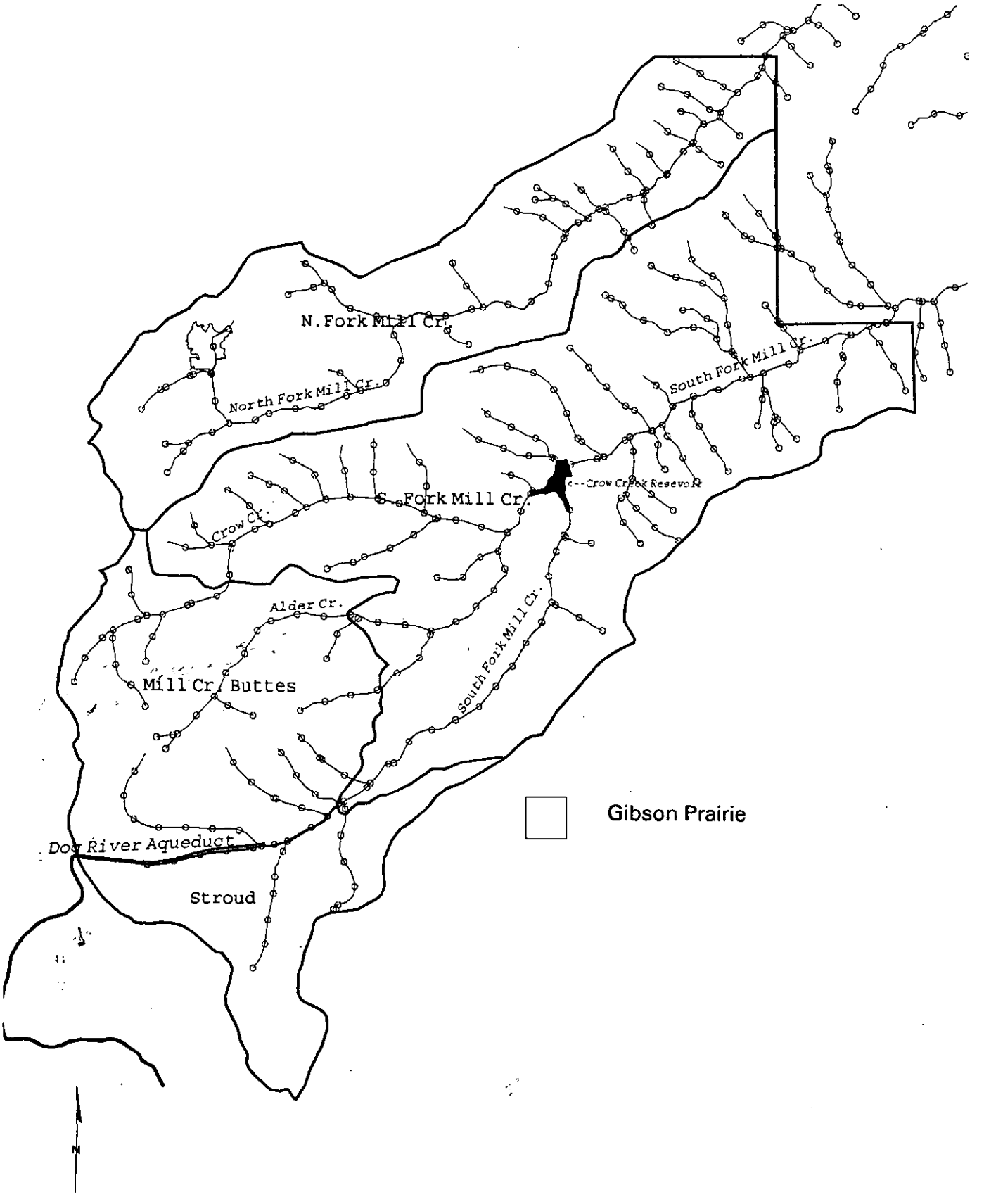
Cutthroat trout were seen in Crow Creek upstream approximately 3.0 miles after which intermittent stream conditions are a likely barrier to fish, at least in summer and fall. In Alder Creek (a tributary of Crow Creek) cutthroat trout were noted upstream approximately 0.8 miles above the reservoir. Fish captured in Crow Creek Reservoir with gill nets in 1993 were all cutthroat trout. Flooding in February 1996 affected in-stream and riparian conditions throughout the watershed, particularly below the water treatment plant.

Forty-three aquatic mollusk species are listed as survey and manage species in the Record of Decision for Amendments to Forest Service and Bureau of Land Management planning documents within the Range of the Northern Spotted Owl (1994). Only two of the 43 listed are known to occur on the Mt. Hood National Forest. Both of these species are covered under survey strategies one and two, manage known sites and survey prior to activities to be conducted after 1999, respectively. The basalt Juga *Juga (oreobasis)n. sp.*2 is found in perennial springs with gravel substrates and likely feeds on periphyton and perilithon. Occupied springs are sometimes surrounded by basalt talus. The Columbia duskysnail *Lyogyrus n. sp.1 is found in cold, well oxygentated springs on soft substrates (sand/silt).* Preferring slow water areas this snail appears to feed upon decaying organic matter. Threats to both species include timber harvest, road building, and fire. It is possible both of these species are present within the watershed but surveys have not been conducted. Potential habitat is likely present however. (See Appendix J for more information)

[1]The Wicks Treatment Plant is the filtering plant for the City of The Dalles domestic water. It is located down stream from the Mill Creek Falls and on the South Fork Mill Creek.

Figure 2-7

Mill Creek Watershed Streams



Chapter III

Figure 3-1

Mill Creek Watershed 3600ft contour and Crow Creek Resevoir

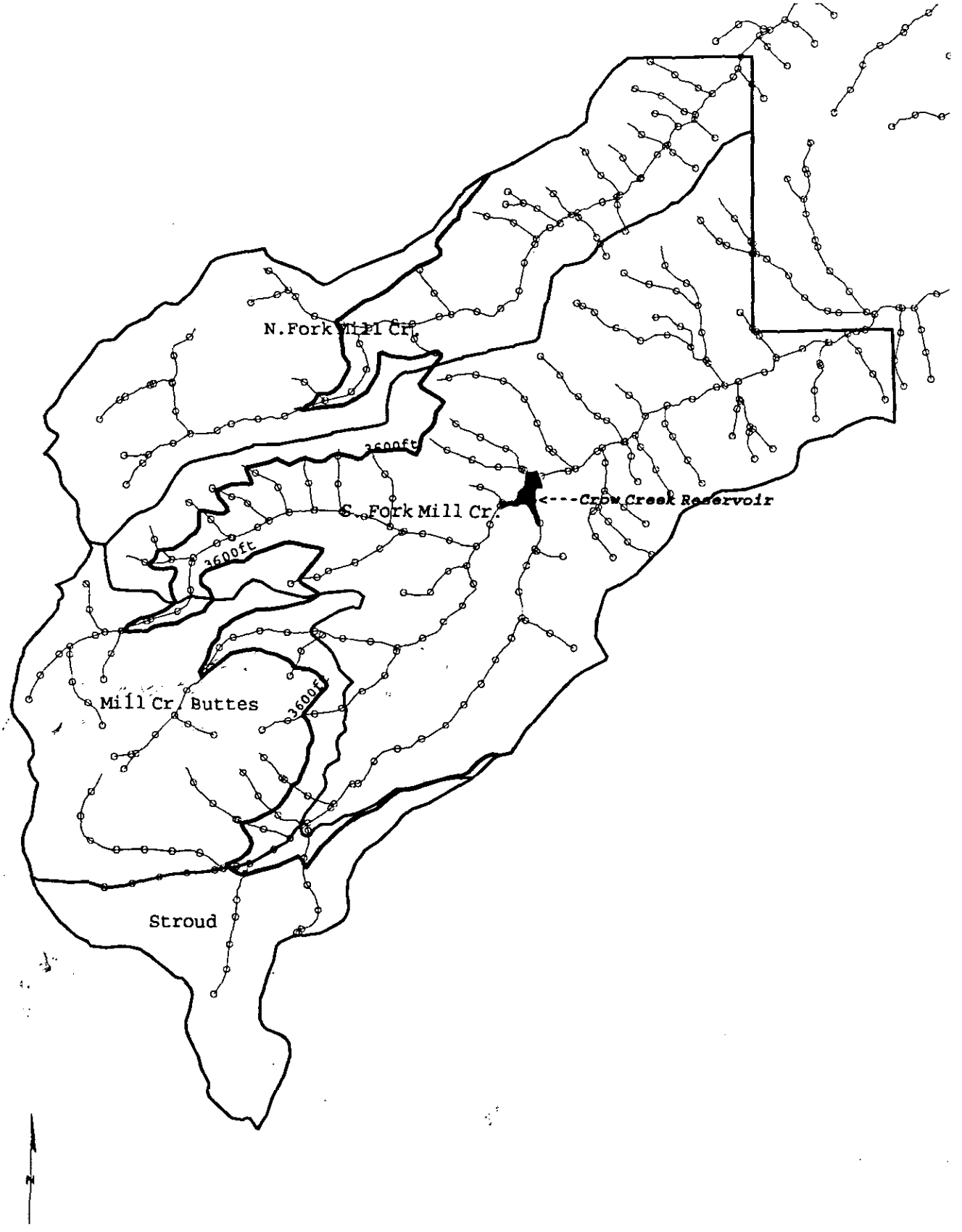
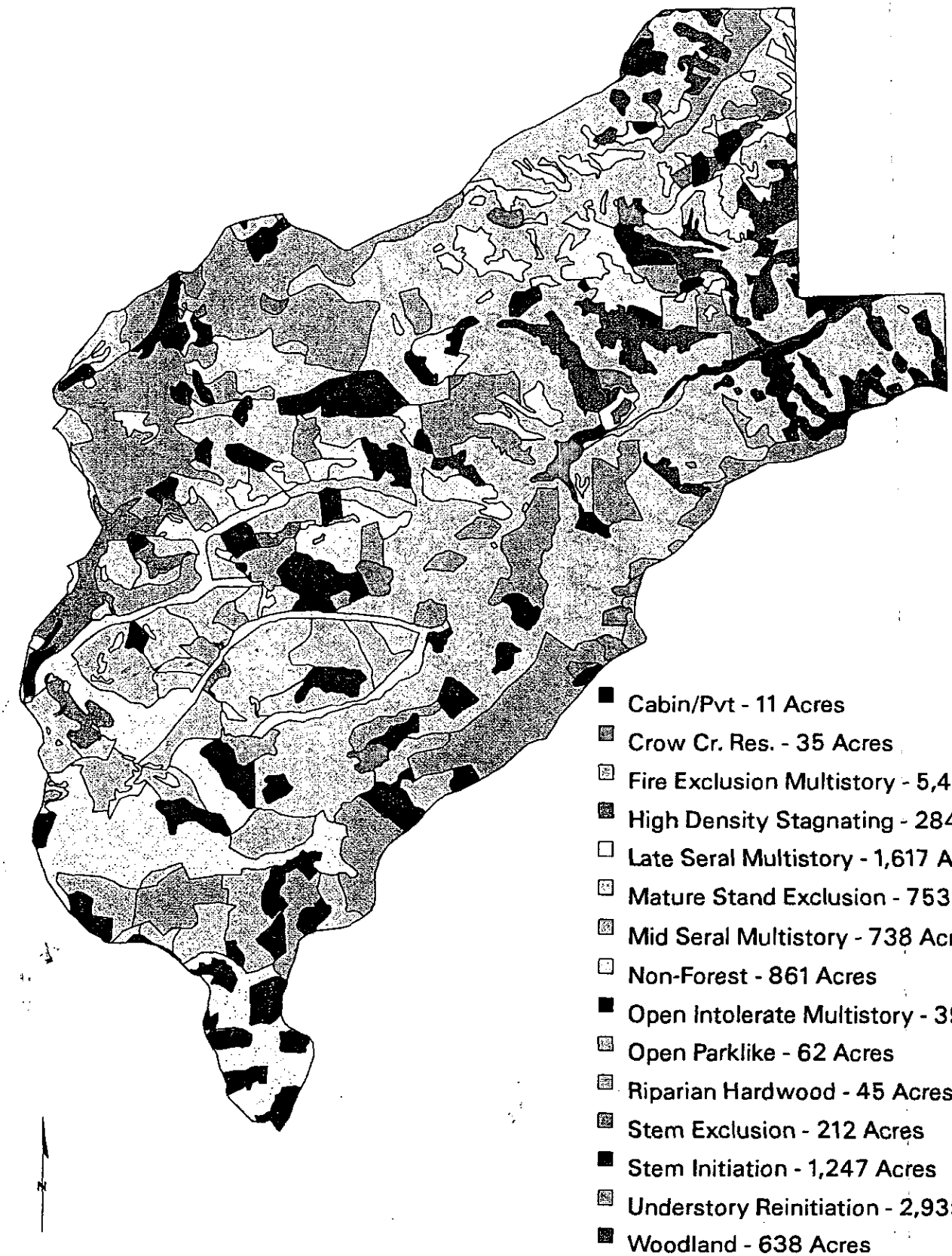


Figure 3-2

Mill Creek Watershed Stand Structure



Note: A description of each stand structure is in the glossary.

Chapter III: Question 1: How are the current disturbance regimes influencing the species composition, stand and landscape patterns?

This narrative describes everything that can also be located in Table III-1. The Table is provided for the ease of the readers in locating specific information quickly. See figure 3-1, for identifying specific locations on the ground (i.e. 3600 ft contour, Crow Creek Reservoir). The Forest Zone map, figure 2-4 is the same as the Fire Regime map, figure 2-5, they can be used interchangeably and the codes are the same. Refer to figure 3-2 for the stand structure (veg schema mapped. Definitions of veg schema can be found in the Glossary pg. 9). Figures are of the portion of Mill Creek Watershed that lie within the forest boundary.

North Fork Landscape Unit

The primary disturbances in the North Fork landscape unit have been **timber harvest, fire/fire exclusion, insects and pathogens, road construction, and grazing. Wetland alteration** at Gibson Prairie has also occurred.

PORTION OF LANDSCAPE UNIT ABOVE 3600'

Above about 3600' in elevation the landforms of this landscape unit tend to be more gently rolling and less dissected than the lower portion. There is relatively little late seral forest in this area, suggesting that **fire** impacted much of this landscape unit between 80 and 200 years ago. Most of this area is mapped as Fire Regime Group 4, which typically has infrequent stand replacement fires, so it appears to be in a stage of recovery following a period of widespread disturbance. *Unharvested areas are mostly large mid-seral* patches of the [1]*fire exclusion multistory* structure category, dominated by ponderosa pine, Douglas-fir, lodgepole pine and grand fir. Grand fir and Douglas fir are the primary regenerating species. Riparian areas typically have a high proportion of western redcedar in addition. Being largely within Fire Regime Group 4, this area has not been as affected by **fire exclusion** as areas with Fire Regime Group 3. In this area, the long period of time between fires would have naturally allowed succession by Douglas-fir and grand fir, and a diminished role for Ponderosa pine in later seral stages.

Extensive **timber harvest** has resulted in a coarse-grain landscape of *stand initiation* and *understory reinitiation* patches (note: although these partial cut and thinned areas are classified as understory reinitiation stands by definition, in many cases they do not contain an abundance of regenerating trees). These areas are dominated for the most part by early seral species - Douglas-fir, ponderosa pine, and western larch. Smaller but significant amounts of other species are also found, including grand fir, and (at higher elevations) Pacific silver fir, western white pine, Engelmann spruce and western hemlock. Along the northwestern perimeter of the North Fork LU near Gibson Prairie are harvest units that have been artificially stocked with mostly Ponderosa pine, in response to root rot and spruce budworm problems (Ponderosa pine is a non-host species for both). At these higher elevations, it is somewhat questionable that Ponderosa pine was historically such a large component of the stand (Engelmann spruce, lodgepole pine, Douglas-fir, and western larch were probably the dominants), and this practice may be driving the future stands in a direction away from their natural species composition. Areas subjected to timber harvest and **road construction** within this landscape unit also have a high proportion of persistent non-native grasses, a result of forage and erosion-control seeding. Knapweed, a noxious weed, also occurs along roadsides and in waste areas.

The area mapped as *riparian hardwood* is dominated by alder, and contains a small clone of quaking aspen, averaging 25-30" dbh. Aspen is rare in this area, and these trees are exceedingly large for the Cascades range as a whole. A fire about 80 years ago in the adjacent conifer stand probably created open conditions for these aspens to thrive, and now the conifers are encroaching. **Timber harvest** of conifers may be the only way this clone of aspens can be perpetuated.

[1] Definitions of all the Vegetation Schema described in this chapter can be located in the Glossary starting on page 9.

Insects and root rots have recently been active in this upper portion of the landscape unit. The species most affected have been Pacific silver fir, grand fir and Douglas-fir (by western spruce budworm) and lodgepole pine (by mountain pine beetle). Densely stocked stands have experienced the most damage. In addition, significant amount of damage from fir engraver occurred in the Gibson Prairie area in the 1970's, and fir engraver activity has increased throughout the LU in the last two decades. The impacts of insects and root rots have been primarily at the stand level, causing mortality of individual or small groups of trees.

Given existing stand structure conditions, the following insects constitute the greatest risks to this area:

Western spruce budworm - in *fire-exclusion multistory, late seral multistory* and *mid-seral multistory* stands with a high component of Douglas-fir, grand fir and Pacific silver fir.

Mountain pine beetle - in *high density stagnating* stands at the southwest edge of the LU that are dominated by lodgepole pine.

Douglas-fir beetle - in mature unmanaged stands dominated by Douglas-fir, especially at the western edge of the LU where windthrow is a hazard.

Fir engraver - in mature stands and shelterwoods with a significant amount of grand fir or Pacific silver fir, especially where root disease is present.

Most of the landscape unit west of Rd. 630 is within the Gibson Prairie Pasture of the Long Prairie Grazing Allotment, which has documented **grazing** back to 1906 (grazing may have occurred here as early as the 1880's). The whole allotment is operated under a three pasture rest-rotation system, such that each pasture is completely rested one year out of every three. Fencing, water developments and grass seeding have been carried out to facilitate an even distribution of animals, and to prevent resource damage, and have been in place at least 40 years. As a result, non-native forage species dominate, (and are also prevalent in clearcuts for transitory grazing). Gibson Prairie itself (only a small portion of the area designated in the allotment), is an **altered wetland**, (probably formerly dominated by native sedges, grasses and alder), having altered drainage patterns and a water impoundment.

PORTION OF LU BELOW 3600'

Below 3600' in elevation, the valley of the North Fork becomes deeper and more dissected. At the same time, the environment quickly becomes drier and warmer due to the steep precipitation and elevation gradients. **Fire** has historically played a more dynamic role here than at higher elevations. Fire Regime Group 3 dominates this area, and reflects a combination of infrequent stand replacement fires and more frequent understory fires. Patches of Fire Regime Groups 1 and 2 also occur low in the drainage and on south-facing slopes; these areas are characterized by relatively frequent low-intensity ground fires. **Exclusion of fire** has thus significantly changed the disturbance regime and resulting landscape, manifesting itself in a greater preponderance of grand fir (at the expense of Ponderosa pine and Douglas-fir) in the conifer stands, and in higher stem densities, more dead material and a greater number of canopy layers than would normally be the case, increasing the risk of a stand replacement fire. On the south side of the North Fork, the Schoolmarm fire of 1967 has resulted in a roughly 9600-acre patch of *stand initiation* structure type. Fire exclusion may have exacerbated the intensity of this event.

Fire exclusion has also probably increased the probability of outbreaks of certain **insects**, by creating a landscape dominated by *fire exclusion multistory* stands with a high proportion of grand fir and Douglas-fir. This has provided more host material for fir engravers, Douglas-fir beetles and western spruce budworm. Outbreaks of these insects have occurred recently and appear to be continuing. Recent activity has created small pockets of mortality or killed individual trees in stands. Mountain and western pine beetles are also a risk in mature stands in this portion of the landscape, with increasing hazard where the proportion of pine is greater.

The lower elevation portion of this landscape unit has been much less affected by **timber harvest** than above, with only a few harvest units occurring on the upper ridges and one large area on the floodplain/lower slopes just west of the National Forest boundary (a recent land acquisition). For the most part, the portion within the National Forest is dominated by tracts of *fire exclusion multistory* forest fragmented by natural grassy *non-forest* openings and *oak woodlands*.

East of the National Forest boundary, the conifer element rapidly declines due to climate, and *oak woodlands* mixed with natural grassy *non-forest* openings dominate the landscape. As the floodplain of the North Fork widens, a narrow band of *riparian hardwood* forest occurs. **Fire exclusion** and **grazing** have probably affected the structure of oak woodlands, but the extent and nature of impacts is unclear. Persistent non-native grass species (most commonly, voodoo grass and cheatgrass) are abundant in grassy openings and oak woodlands, as result of **grazing** and other human influences.

South Fork Landscape Unit

The major disturbances in the South Fork landscape unit have been **fire and fire exclusion, timber harvest, insects, dam construction and water diversion, road construction and grazing.**

There is relatively little late seral forest in this landscape unit, suggesting **fire** has affected much of the area between 80 and 200 years ago. Fire Regime Group 3 dominates the western half, reflecting a combination of infrequent stand replacement fires and frequent low intensity underburning. Most of the eastern half falls within Fire Regime Group 2, which is characterized by low intensity fires every few decades. **Exclusion of fire** has probably significantly changed the disturbance regime and resulting stand structures, with an increase in grand fir over Ponderosa pine and Douglas-fir, and in higher stem densities, more dead material, smaller average tree diameters, and greater number of canopy layers than would be the case with natural fire cycles. This also has the effect of significantly increasing the fuel loadings and the resulting likelihood of a major stand replacement fire in the future. An exception to this scenario is the riparian portion of the landscape, mapped as Fire Regime Group 4 and dominated by mid-seral stands of grand fir, Douglas-fir and western redcedar, where infrequent stand replacement fires are likely the rule, and where fire exclusion is less likely to push stands away from their natural successional pathways and disturbance cycles.

The overall landscape pattern in the South Fork landscape unit within the National Forest is a matrix of mid-seral *fire exclusion multistory* forest dominated by Ponderosa pine, Douglas-fir and grand fir, fragmented by a combination of natural *non-forest* grassy openings and *oak woodlands* in the eastern, lower elevation half, and by *stand initiation* patches created through **timber harvest** in the western half. On the south side of the drainage and immediately northwest of Crow Creek Dam, large areas of *understory reinitiation* structure type have been created through partial cutting; regeneration is sporadic in these stands. Timber harvest has maintained the early seral species dominance (primarily Douglas-fir and Ponderosa pine, along with western larch, lodgepole pine and western white pine at upper elevations), which is probably reflective of what would occur under a natural fire regime. Fragmentation of the western, upper elevation portion of this landscape unit represents a significant departure from prelogging landscape patterns. Interior habitat and connectivity have both decreased as a result. Areas subjected to timber harvest and **road construction** tend to have a high proportion of persistent non-native grasses as a result of erosion-control seeding. Noxious weeds (mainly knapweed) also occur in some disturbed areas.

Insects have recently been active primarily in the upper elevations of the South Fork landscape unit. The species most affected have been grand fir and Douglas-fir (by western spruce budworm) and Ponderosa pine (by mountain and western pine beetles). Densely stocked stands seem to have experienced the most damage. In addition, significant amount of damage from fir engraver occurred in upper Crow Creek in the 1970's, and fir engraver activity has increased in the last two decades. Insect infestations appear to have occurred episodically, resulting in mortality of individual or small groups of trees.

Given existing stand structure conditions, the following insects constitute the greatest risks to this area:

Western spruce budworm - in *fire-exclusion multistory, late seral multistory* and *mid-seral multistory* stands with a high component of Douglas-fir, grand fir and Pacific silver fir.

Mountain and western pine beetle - in mature stands and shelterwoods with a significant proportion of Ponderosa pine, mostly in the lower half of the LU.

Fir engraver - in mature stands and shelterwoods with a significant amount of grand fir, especially where root disease is present.

The construction of **Crow Creek Dam** and withdrawal of water from the South Fork system by the City of the Dalles has altered the forest structure of the inundated area. Below the dam, the flow regime is regulated, with less extreme peak and low flows. As a result the floodplain is not disturbed by flood events as often, and the *riparian hardwood* forest has probably become more stable, with less regeneration. In the upper drainage, diversion of water from Dog River since the 1920's has increased summer flows, and appears to have significantly enhanced the growth of western redcedar within the riparian zone.

Near and below the National Forest Boundary, the conifer element rapidly declines, and *oak woodlands* mixed with natural grassy *non-forest* openings dominate the landscape. Isolated small building sites and small areas maintained as pasture also occur in this area. Fire regime groups have not been mapped for this area, but Fire regimes groups 1 and 2 are the most likely categories, reflecting a high frequency, low intensity pattern of fire events. **Fire exclusion** and **grazing** have probably affected the structure of oak woodlands, but the extent and nature of impacts is unclear. Persistent non-native grass species, especially voodoo grass, cheatgrass and other bromes, are abundant in grassy openings and oak woodlands, as result of grazing and other human influences. The Mill Creek Research Natural Area (RNA) lies within the National Forest portion of this area. The pressure of non-native grasses and the risks of grazing (unauthorized) and noxious weed encroachment make it advisable to complete a management plan for the RNA in the near future.

Mill Creek Buttes Landscape Unit

The dominant disturbances in the Mill Creek Buttes LU have been **fire and fire exclusion, timber harvest, insects and pathogens, and road construction.**

The majority of this landscape unit consists of a relatively unfragmented matrix of mid-seral forest, with late seral forest occurring at the southern boundary. It appears that **fire** played a significant role in this area during the period 80 to 200 years ago. The upper elevations are mapped as Fire Regime Group 4, reflecting a fire regime of infrequent stand replacement fires. *Mid-seral multistory* stands dominate this part of the LU. These, along with the few *late seral multistory* stands that occur here, are generally the most species-rich stands within the watershed. Pacific silver fir, Engelmann spruce, western white pine, western larch, Douglas-fir, grand fir, western hemlock, western redcedar and lodgepole pine are the most common species. The remainder of the area is in Fire Regime Group 3, indicating drier environments which typically have a combination of infrequent stand replacement events and more frequent low intensity fires. *Fire exclusion multistory* stands dominate sites with Fire Regime Group 3, and are generally composed of Ponderosa pine, Douglas-fir and grand fir. On the south side of Mill Creek Buttes an area of Ponderosa pine, mapped as Fire Regime Group 2, occurs. It is believed that this site was probably maintained by fire in the past, and is likely to experience an increase in grand fir and Douglas-fir without underburning. **Fire exclusion** has probably not significantly altered species composition, stand structures or landscape patterns in areas mapped as Fire Regime Group 4, but has resulted in an increase in fire-susceptible species, higher stem densities, lower average tree diameters and greater number of canopy layers in Fire Regime Groups 2 and 3. Where Fire regimes groups 2 and 3 are found, there is probably now more *fire-exclusion multistory* and less *open intolerant multistory* stand type than in the past under a natural fire regime. There is also more accumulation of dead material, and a resulting higher risk of stand replacement fire.

Timber harvest has not occurred extensively in this landscape unit. Partial cutting and clear cutting have resulted in small patches of *understory reinitiation* and *stand initiation* structure types in the northern half of the LU. Harvested areas typically are shifted towards early seral species, such as Douglas-fir, Ponderosa pine, western larch, and western white pine. Timber harvest and **road construction** have resulted in an increase in persistent non-native grass species where erosion control and forage seeding have occurred.

This landscape unit evidences the highest amount of impacts from insects of any in the watershed. In the western portion of the landscape unit, significant acreage of *high density stagnating* stands occurs. These stands originated from fires near the turn of the century, and are currently experiencing significant mortality due to both competition and **insect activity**. The species most affected have been Pacific silver fir, grand fir and Douglas-fir (by western spruce budworm) and lodgepole pine (by mountain pine beetle). The impacts of insects and root rots have been primarily at the stand level, causing mortality of individual or small groups of trees. The increase in dead material has raised the risk of stand replacement fire.

Given existing stand structure conditions, the following insects constitute the greatest risks to this area:

Western spruce budworm - in *fire-exclusion multistory, late seral multistory* and *mid-seral multistory* stands with a high component of Douglas-fir, grand fir and Pacific silver fir.

Mountain pine beetle - in *high density stagnating* stands that are dominated by lodgepole pine; also, along with western pine beetle, in mature stands and shelterwoods with a significant proportion of Ponderosa pine (limited acreage in this LU).

Douglas-fir beetle - in mature unmanaged stands dominated by Douglas-fir, especially at the western edge of the LU where windthrow is a hazard.

Fir engraver - in mature stands and shelterwoods with a significant amount of grand fir or Pacific silver fir, especially where root disease is present.

In the upper drainage, diversion of water from Dog River since the 1920's has increased summer flows, and appears to have significantly enhanced the growth of western redcedar within the riparian zone.

Stroud Landscape Unit

The primary disturbances in the Stroud landscape unit are **fire, timber harvest, wind, road construction and insects and pathogens.**

This landscape unit contains the most extensive tracts of late seral forest in the watershed. The landscape pattern consists of a highly fragmented matrix of late and mid-seral forests. This landscape unit is mapped as Fire Regime Group 4, indicating infrequent stand replacement fires are the rule. Most of the *late seral multistory* stand structure type within the watershed occurs in this LU, suggesting that **fire** has not played a significant role in this portion of the landscape for centuries. These are diverse stands, both structurally and with regard to species composition. Pacific silver fir, Engelmann spruce, western white pine, western larch, Douglas-fir, grand fir, western hemlock, western redcedar and lodgepole pine commonly occur in various combinations. *Mid-seral multistory* stands typically have the same combinations of species. These stands, mostly occurring in the northern, lower elevation half of the landscape unit, have experienced a stand replacement event between 80 and 200 years ago. Fire exclusion appears to have had little effect on the species composition or structure of stands in this area.

Timber harvest has significantly fragmented the Stroud landscape pattern with patches of both the *stand initiation* and *understory reinitiation* stand structure categories. Interior habitat and connectivity have declined. Timber harvest has resulted in the increase of the proportion of early seral species like Douglas-fir, lodgepole pine, western white pine, western larch and Ponderosa pine. In several shelterwood units, **windthrow** has been a significant problem,

resulting in a shift towards the *stand initiation* structure type. Persistent non-native grasses are present in harvested stands, and along roadsides, a result of forage seeding and erosion control related to timber harvest and **road construction**.

Insects and root rots have recently been active in this landscape unit. The species most affected have been Pacific silver fir, grand fir and Douglas-fir (by western spruce budworm) and lodgepole pine (by mountain pine beetle). The impacts of insects and root rots have been primarily at the stand level, causing mortality of individual or small groups of trees. The increase in dead material has raised the risk of stand replacement fire.

Given existing stand structure conditions, the following insects constitute the greatest risks to this area:

Western spruce budworm - in *fire-exclusion multistory, late seral multistory* and *mid-seral multistory* stands with a high component of Douglas-fir, grand fir and Pacific silver fir.

Mountain pine beetle - in *high density stagnating* stands that are dominated by lodgepole pine.

Douglas-fir beetle - in mature unmanaged stands dominated by Douglas-fir, especially at the western edge of the LU where windthrow is a hazard.

Fir engraver - in mature stands and shelterwoods with a significant amount of grand fir or Pacific silver fir, especially where root disease is present.

Rural Landscape Unit

The dominant disturbances in this landscape unit are **fire/fire exclusion, grazing, agriculture, roads and housing, and beaver extirpation.**

This portion of the watershed is below the zone of continuous closed canopy forest. Under natural conditions, the area consisted of a mosaic of oak woodlands and natural grassy openings, with scattered groups or individual Ponderosa pine. **Fire** has historically been an important process in this LU. Fire regime mapping has not been done for the area (since it is outside the NF boundary), but Fire Regime Group 1 probably dominates, with Fire Regime Group 2 possibly occurring in valley bottoms. Natural fires probably occurred every few years to decades, and were probably low intensity underburns for the most part. **Fire exclusion** has probably resulted in an increase in density of oak stands, and possibly has allowed them to expand in area. It is not known to what extent large-diameter oaks occurred in the LU in the past, nor what effects fire and fire exclusion may have had on them.

Grazing has been widespread in this LU. Non-native grasses are a dominant component throughout the area, resulting both from seeding and overgrazing.

Agriculture has significantly altered the composition and ecological function of this LU. In wheat fields, orchards and landscaped areas, exotic species dominate. Overall species diversity and biomass production is likely increased above natural levels, highly subsidized by irrigation, tillage and fertilization. The landscape pattern has changed from a continuous mosaic of woodlands and grassy areas, to one of highly contrasting geometric patches. Connectivity is significantly reduced, especially between upland and riparian areas. Fencing, particularly in orchards, has changed migration patterns of deer and elk. Withdrawal of water for irrigation has reduced the amount of water spreading across the riparian floodplain on a seasonal basis, and likely reduced the amount of riparian hardwood forest and wetlands. The **extirpation of beavers** may have had a similar effect on hydrologic function. Although it is not known how extensively beavers occupied the area prior to settlement, their presence has been documented by records of trapping in the early 1800's. The wide floodplain would have provided significant beaver habitat. Where beaver dams were present, floodwaters would have been slowed and spread over a wider area than is currently the case. Wetland vegetation (probably willows and graminoids, primarily) would have been more extensive than today.

Roads and housing have also resulted in an increase in non-native species and noxious weeds (especially knapweed), especially along roadways, which provide connectivity for their spread. Other effects are similar to those from agriculture.

The Dalles Landscape Unit

This is the most highly altered portion of the watershed. The primary disturbances are those related to **development** - roads, housing, and industrial/commercial sites. Historically **fire** was the dominant disturbance, and **fire exclusion** may also have affected the current landscape to some degree.

Development has altered what once was a mosaic of oak woodlands and grassy openings, and also the hardwood riparian forest of the Mill Creek alluvial delta. Native vegetation has been replaced by exotic species, including noxious weeds, on a significant portion of the area. Overall plant biodiversity has increased above natural levels, but at the expense of native communities. Biomass production is probably lower, due to the large acreage of hardened surfaces. The landscape pattern has changed from a continuous mosaic of woodlands and grassy areas, to one of highly contrasting, mostly small geometric patches (parks, schoolyards, cemeteries, etc. are examples of larger patches). Stream channelization and development on the Mill Creek delta has resulted in a decline of riparian wetlands and hardwood forest dominated by cottonwood, maple, alder and willow, and has reduced the ability of the system to handle extreme flows without damage to human-built structures.

Natural **fires** probably occurred in this area every few years to decades, and were probably low intensity underburns for the most part. **Fire exclusion** has probably resulted in an increase in density of remaining oak stands, and possibly has allowed them to expand in area. It is not known to what extent large-diameter oaks occurred in the LU in the past, nor what effects fire and fire exclusion may have had on them.

Table III - 1 -refer to figures 2-4, 2-5, 3-1, 3-2. **This table reflects the narrative of Chapter- III Question 1 in table form.**

NORTH FORK LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLU-SION			
Firegroup (FRG)2 (Underburns; inclusions of FRG 1) - 11% of LU within NF	Most of area burned naturally 80-200 years ago (is mid-seral). Natural fire regime favored PIPO and PSME. Fire exclusion has allowed an increase in PSME and ABGR, and a decrease in PIPO and QUGA.	Natural fire would have created mostly OIM stands with infrequent large short-term openings. Most of area is currently mid-seral. Fire exclusion has reduced the amount of OIM, increased FEM, and resulted in more canopy layers, denser stocking and smaller average tree diameters. May also have affected structure of oak woodlands, but impacts not determined. Schoolmarm Fire created 9600-ac. SI patch, an event possibly intensified by fire exclusion.	Natural fire resulted in a matrix of OIM and OP, fragmented by oak woodlands and natural NF openings in lower 2. Fire exclusion has expanded multi-canopy conifer habitat, and through fuel accumulation, has increased the likelihood of a large stand-replacement fire.
FRG 3 (Stand repl. + underburns) - 26% of LU within NF	Same as above	Natural fire would have created a mix of FEM and OIM stands with infrequent large short-term openings. Effects of fire exclusion same as above.	Same as above, except OP probably would not have been a major stand type under natural fire regime.
FRG 4 (Stand repl.) - 54% of LU within NF	Most of area burned naturally 80-200 years ago (is mid-seral). PIPO, PSME, PICO, PIMO, PIEN and ABGR are dominants, and ABGR, PIEN, ABAM and TSHE are increasing. These trends are in tune with natural fire regimes.	Natural fire would have created a mix of LSM and FEM. Stands are currently mostly FEM, moving towards LSM. Effects of fire exclusion are similar to natural fire regime.	Natural fire would have resulted in a relatively continuous matrix of LSM, FEM and MSE stands, which would exist here if timber harvest had not occurred. Fire exclusion effects negligible.

TIMBER HARVEST Has occurred on 13% of NF acres	In areas with FRG 2 and 3, maintains dominance of early seral spp. (PSME, PIPO), similar to successional pathway with natural fire. In areas with FRG 4, late seral species (ABGR, ABAM, PIEN) decline, truncating natural successional pathways. Non-native grasses in forage-seeded areas	Introduction of SI and UR stands in short term (few decades), possibility of need for thinning in the future.	Upper part of watershed has extensive openings and areas with reduced canopy closure. Interior habitat and connectivity have been reduced, but the landscape is not generally fragmented into small patches. Lower portion is naturally fragmented, and timber harvest has increased size of openings.
INSECTS/ PATHOGENS	Mortality in ABGR, ABAM, PSME and PICO, mostly upper elevations. Spruce budworm, fir engraver and mtn. pine beetle are most common insects. Increased dominance of non-host spp. (PIPO, PIMO, PIEN, LAOC) in affected areas.	Mortality in individual or small groups of trees.	Primarily a fine-scale disturbance process, resulting in relatively small openings. Increase in fuels and likelihood of large stand replacement fire. Related to drought cycles.
WETLAND ALTERATION Gibson Prairie	Elimination of native graminoids and shrubs, shift towards non-native grasses and forbs.	Flow channelization and pasture seeding have shifted area from a wet shrub-sedge meadow to a dry grass-forb meadow.	Wetland may have lost some of its hydrologic function due to channelization of flow.
GRAZING Long Prairie Allot. - 2432 ac.	Large increase in non-native grasses below NF boundary, at Gibson Prairie and in timber harvest areas.	Negligible effect.	Negligible effect
WIND West ridge area primarily	Negligible effect	Damage has occurred mostly in UR stands, reducing the numbers of leave trees in some units.	Increased effects of fragmentation, creation of high-contrast edges with adjacent forest stands.

ROADS Whole LU = 1.67 mi/mi^2; NF lands = 1.81 mi/mi^2	*Spread of non-native grasses and noxious weeds along roadsides and waste areas.*	Permanent alteration of rights of way.	Provides connectivity for the spread of noxious weeds.

SOUTH FORK LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLUSION			
FRG 2 (Underburns) 30% of LU within NF	Most of area burned naturally 80-200 years ago. Natural fire regime favored PIPO and PSME. Fire exclusion has allowed an increase in PSME and ABGR, and a decrease in PIPO and QUGA.	Natural fire would have created mostly OIM and QP stands with infrequent large short term openings. Most of the area is currently in a mid-seral stage. Fire exclusion has reduced the amount of OIM, increased FEM, and resulted in more canopy layers, denser stocking and smaller average tree diameters. May also have affected structure of oak woodlands, but impacts not determined.	Natural fire has resulted in a matrix of mid-seral conifer forest fragmented by oak woodlands and natural nonforest openings. Fire exclusion has expanded multi-canopy conifer habitat, and through fuel accumulation, has increased the likelihood of a large stand-replacement fire.
FRG 3 (Stand repl. + underburns) - 57% of LU within NF	Same as above	Natural fire created mix of FEM and OIM stand types with infrequent large short-term openings. Effects of fire exclusion same as above.	Natural fire, in the absence of timber harvest, created a relatively continuous matrix of mid-seral forest. Fire exclusion effects same as above.
TIMBER HARVEST Has occurred on 12% of NF acres	Maintains dominance of early seral species (PSME, PIPO), similar to successional pathway with natural fire. Introduction of non-native grasses in forage-seeded areas.	Introduction of SI and UR stands in short term (few decades), possibility of need for thinning in the future.	Upper half of watershed is significantly fragmented. Interior habitat and connectivity have been reduced. Lower half is naturally fragmented, and timber harvest has increased size of openings.
INSECTS/ PATHOGENS Less significant than other LUs	Mortality in ABGR and PSME (mainly from spruce budworm), mostly upper elevations. Some mortality in PIPO, due to pine beetles. Fir engraver has affected ABAM and ABGR.	Mortality in individual or small groups of trees.	Primarily a fine-scale disturbance process, resulting in relatively small openings. Increase in fuels and likelihood of large stand replacement fire.

DAM/H20 DIVER-SION	Possible decline in ACMA, POTR2 and other hardwoods below Crow Creek Dam.	Decrease in extent of RH forest type below dam. Enhanced growth of THPL in upper drainage (Dog River diversion).	Created 26 acre body of open water.
GRAZING Excluded from NF area since 1920's	Large increase in non-native grasses (BRTE, VEDU, etc.) in oak woodlands and nonforest grassy openings. Areas above NF boundary have partially recovered (i.e., Mill Cr. RNA), but trespass occurs occasionally.	Negligible effect. May have affected structure of oak woodlands, but nature of effects undetermined.	Negligible effect
ROADS Whole LU = 1.84 mi/mi^2; NF lands = 2.23 mi/mi^2	Spread of non-native grasses and noxious weeds, mainly knapweeds, along roadsides and waste areas.	Permanent alteration of rights of way.	Provides connectivity for the spread of noxious weeds.

MILL CREEK BUTTES LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLUSION			
FRG 3 (Stand repl. + underburns; inclusions of FRG 2) - 54% of LU	Natural fire regime favored PIPO and PSME. Fire exclusion has allowed an increase in PSME and ABGR, and a decrease in PIPO.	Most of area burned 80-200 years ago (is mid-seral). Natural fire would have created mix of FEM and OIM stands with infrequent large short-term openings. Fire exclusion has reduced the amount of OIM, increased FEM, and resulted in more canopy layers, denser stocking and smaller average tree diameters.	Natural fire resulted in a relatively unfragmented matrix of OIM and FEM. Stand repl. fire affected large tracts infrequently. Fire exclusion has expanded multi-canopy conifer habitat, and through fuel accumulation, has increased the likelihood of a large stand-replacement fire.
FRG4 (Stand repl.) - 42% of LU	Natural fire has created a mix of late and early seral conifers - ABAM, PIEN, PIMO, LAOC, PSME, ABGR, TSHE, THPL, PICO.	Predominance of LSM (burned >200 years ago)and MSM (burned 80-200 years ago) stands, with smaller acreages of mid-seral HDS type. Affects of fire exclusion appear to be negligible.	In absence of timber harvest, created a fairly continuous matrix of late and mid-seral stands, similar to what currently exists.
TIMBER HARVEST Has occurred on 7% of LU acres	Shift towards early seral species (PSME, PIMO, PICO, LAOC and PIPO) in managed areas, creating spp. mixes similar to what natural fire would.	Introduction of SI and UR stands in short term - few decades, possibility of need for thinning in the future.	Introduced a small number of open patches on northern perimeter, but has not significantly affected interior habitat or connectivity.
INSECTS/ PATHOGENS Widespread in LU	Mortality in ABAM, ABGR, PSME from spruce budworm, and PICO from mtn. pine beetle. Fir engraver has affected ABAM and ABGR. Douglas-fir beetle may be active in windthrow areas. LAOC, PIEN, PIMO, TSHE and PIPO are affected less, and tend to increase in dominance.	Mostly mortality in individual or small groups of trees, but in some high density stands, mortality has been significant.	A widespread, fine-scale disturbance process, resulting in relatively small openings. Increase in fuels and likelihood of large stand replacement fire.

WIND SW portion of LU	Negligible effect	Damage has not been extensive, is mainly a risk if stands are opened up in the SW portion of this LU	Could result in enlarged openings in SW portion of LU
ROADS 1.38 mi/mi^2	Spread of non-native grasses and noxious weeds along roadsides and waste areas.	Permanent alteration of rights of way.	Provides connectivity for the spread of noxious weeds. Not a significant factor in this LU.

STROUD LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLUSION FRG 4 (Stand repl) - 100% of LU.	Natural fire created a mix of late and early seral conifers - ABAM, PIEN, PIMO, LAOC, PSME, ABGR, TSHE, THPL, PICO, similar to what is currently present in unharvested areas.	North half of LU burned naturally 80-200 years ago, south half >200 years ago. Currently area has predominance of LSM stands in south half, and MSM stands in north half.	In absence of timber harvest, created a fairly continuous matrix of late and mid-seral stands. Fire exclusion effects are negligible in this LU.
TIMBER HARVEST Has occurred on 29% of LU acres	Shift towards early seral spp. (PSME, PIMO, PICO, LAOC and PIPO) in managed areas, truncating succession. Introduction of non-native grasses in forage-seeded areas.	Introduction of SI and UR stands in short term (few decades), possibility of need for thinning in the future.	Significant fragmentation of matrix. Little or no interior habitat remains, and connectivity of late seral forest is limited. Smaller average patch sizes than natural fire would have created.
INSECTS/ PATHOGENS Widespread in LU	Mortality in ABAM, ABGR, PSME from spruce budworm, and PICO from mtn. pine beetle. LAOC, PIEN, PIMO, TSHE and PIPO are affected less. Douglas-fir beetle may be active in windthrow areas.	Mostly mortality in individual or small groups of trees, but in some high density stands, mortality has been significant.	A widespread, fine-scale disturbance process, resulting in relatively small openings. Increase in fuels and likelihood of large stand replacement fire.
ROADS 3.95 mi/mi^2	Spread of non-native grasses and noxious weeds along roadsides and waste areas.	Permanent alteration of rights of way.	Provides connectivity for the spread of noxious weeds.
WIND Significant in this LU and likely to persist	Negligible effect	Damage has occurred mostly in UR stands. Has significantly reduced the numbers of leave trees in some units, shifting them towards SI structure.	Has increased the effects of fragmentation and creation of high-contrast edges.

RURAL LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLUSION FRG 1 & 2 - 100% of LU	Natural fire regime favors PIPO and QUGA, and maintains grassy openings. Fire exclusion has probably affected structure more than composition.	Fire exclusion may have allowed trees to expand into more open areas, and caused increased density in woodlands. There is little large oak habitat remaining, and it is not known what its extent was historically.	Natural fire resulted in a mosaic of oak woodlands, sometime with pine, and grassy openings. Woodland component may have expanded with fire exclusion.
GRAZING	Shift towards non-native grasses, and in some places noxious weeds (especially knapweed), is pronounced in pastures and overgrazed areas.	Introduction of pastures as a structure type.	Negligible effect to overall landscape pattern, except for widespread shifts in species composition to non-natives. Fences may affect connectivity for some species.
AGRICULTURE	Shift toward non-native crop species (wheat, hay, orchards, landscaping), and away from native bunchgrasses, oaks and pine. Loss of native species diversity.	Introduction of geometric pastures, hayfields and croplands as a structure type, also equipment storage areas, loading yards, etc. Patches tend to be large and homogeneous.	Fragmentation of woodland and grassland matrix with patches of crops; decline in grassland connectivity in some areas, especially between riparian zone and upland. Water withdrawal for irrigation reduces flows and may have affected floodplain function and amount of riparian hardwood forest.
ROADS, HOUSING	Spread of non-native grasses and noxious weeds along roadsides and waste areas. Introduction of non-native trees, shrubs and herbs for landscaping and home gardens. Increase in overall species diversity.	Introduction of highly modified patch types - residences, gardens, road rights of way, waste disposal sites, etc.	Roads provide connectivity for the spread of noxious weeds. Built-up sites fragment woodland and grassland matrix with patches dominated by non-native species or non-vegetated areas. Roads and residences in riparian zone affect floodplain function and fragment hardwood forest.
BEAVER EXTIRPATION	Reduction of cottonwood, bigleaf maple and willows in riparian zone/floodplain wetlands.	Reduction in riparian hardwood and willow/graminoid wetland patch types.	Stream tends to have less lateral movement, riparian zone is less able to spread floodwaters, increasing peak flows.

THE DALLES LANDSCAPE UNIT

	SPECIES COMPOSITION	STAND STRUCTURE	LANDSCAPE PATTERN
FIRE/FIRE EXCLUSION FRG 1 & 2 - 100% of LU	Natural fire regime favors PIPO and QUGA, and maintains grassy openings. Fire exclusion has probably affected structure more than composition.	Fire exclusion may have allowed trees to expand into more open areas, and caused increased density in woodlands. There is little large oak habitat remaining, and it is not known what its extent was historically.	Natural fire resulted in a mosaic of oak woodlands, sometime with pine, and grassy openings. Woodland component may have expanded with fire exclusion.
ROADS, HOUSING, INDUSTRIAL & COMMERCIAL DEVELOPMENT	Spread of non-native grasses and noxious weeds along roadsides and waste areas. Introduction of non-native trees, shrubs and herbs for landscaping and home gardens. Elimination of most of native vegetation, even though overall species diversity is high. Declines in cottonwood, maple, willow, alder on Mill Creek delta.	Introduction of highly modified patch types - residences, gardens, building sites, parking lost, road rights of way, etc. Loss of hardwood forests and wetlands on Mill Creek delta, replaced by hard surfaced areas.	Significant reduction in patch sizes from what would naturally occur, except for parks, cemeteries, etc. Extensive non-vegetated areas, low biomass production. Riparian function of Mill Creek delta reduced, stream channelized and riparian wetlands largely paved. As a result peak flows have increased and dyking has been required to reduce damage to susceptible structures.

Chapter III: Question 2: How are habitats functioning for terrestrial forest species?

This narrative describes everything that can also be located in Table III-2. The Table is provided for the ease of the readers in locating specific information quickly. Refer to figure 1-2 for location of LUs beyond the forest boundary. .

Downed Wood - National Forest Lands in Mill Creek Watershed.

Course woody debris, is a very important component in any ecosystem, as has been recognized by the land management plans governing this area. Unfortunately, downed wood recommendations and requirments vary greatly by plan and discipline and often use inconsistent units of measure. The Northwest Forest Plan states that province-level plans will establish appropriate levels of downed wood and decay rates and that levels will be "typical" and not require retention of all material where it is highly concentrated or too small to contribute to the downed wood functions over long periods of time. Mill Creek Watershed falls in the Deschutes Province. No province level plan is available.

In the absence of a province level plan, we examined the standards and guidelines and recommendations for the Mt. Hood Forest Plan, Northwest Forest Plan-Matrix lands, and Miles Creek Watershed Analysis (Tables III-3, and III-4). The Northwest Forest Plan recommendations for downed wood apply only if the Forest Plan standards and guidelines require less material than the Northwest Forest Plan. The Northwest Forest Plan also states that the standards and guidelines within it are interim guidance. Further refinement for specific areas, if derived from planning based on watershed analysis and the adaptive management processes, is allowed and encouraged (ROD pg C-41)

It is hard to determine whether the Mt. Hood Forest Plan or the Northwest Forest Plan provides for the greater amount of downed wood. The Northwest Forest Plan recommends a larger number of logs while the Mt. Hood Forest Plan requires larger sized logs. The various measure cannot be compared directly, particularly since the point of measure for diameter is not specified in the Northwest Forest Plan. The resulting log size and weight can vary greatly if the specified diameter is on the small end verses the large end.

The downed wood recommendations in Miles Creek Watershed Analysis are greater than either the Mt. Hood Forest Plan or the Northwest Forest Plan. However, these recommendations are based on data taken primarily on the westside. The eastside does not produce logs of the sizes and amounts specified except in very productive locations. Further, the series lumped under the Mixed Conifer category vary tremendously in their productive capability. In addition, studies in the Northern Region (Montana and Idaho) have shown that stand size class, a substitute for stand age, is a poor predictor of the number of downed logs to expect (Brown and See 1981). Few or no logs may occur for some period of time in any age class/stand size.

While not specifically stated, the Northwest Forest Plan does appear to recognize that downed wood input into the ecosystem is usually episodic in nature, rather than continual. We believe that downed wood input is more eposodic in the moist grand fir series and more continual, but at low levels in the dry grand fir series.

Table III-2 shows a comparison between the recommendations from other forest planning documents. In addition Mill Creek Watershed is listed here to show how it would look given the recommendations from the other planning documents.

Table III-2: Downed Woody Comparision Recommendations from Forest Planning Documents.

Source	Amount	Specifications	Remarks
NW Forest Plan	120 lineal feet per acre.	At least 16" diameter and at least 16 ft long; Decay classes 1 and 2; should reflect species mix of original stand.	Approximately 8 logs per acre and 3 tons per acre. Existing debris should be retained and protected as much as possible from disturbance due to stand treatment.
Mt. Hood Forest Plan -- Soils	15 tons per acre; or at least 80% of naturally occurring levels on sites capable of producing 15 tons.		Evenly distributed, includes material of sufficient size to meet wildlife expectations.
Mt. Hood Forest Plan-- Wildlife	At average of 6 logs per acre.	At least 20" diameter at small end and 40 cubic ft in volume (ex. 20" by 16 ft); Decay classes 1, 2, and 3 preferred. Decay classes 4 and 5 may be substituted if sounder classes are not available.	Smaller sized logs allowed only if stand incapable of producing specified size or stand is too young to have 20" trees. No area greater than 2 acres in size and capable of growing sufficient trees should be without at least 2 logs.
Miles Creek Watershed Analysis	Varies by vegetation series.	At least 21" diameter and 16 ft long, Decay classes 1, 2, and 3.	
Mill Creek Watershed Analysis	Dry Grand Fir 3-13 tons per acre. Moist Grand Fir 10-20 tons per acre.	Dry Grand Fir; At least 1 tree-length log per acre. Moist Grand Fir; At least 3 tree-length logs per acre.	We are assuming in the dry and moist grand fir areas trees are 20" DBH and at least 100' long.

Figure 3-3

Interior Habitat

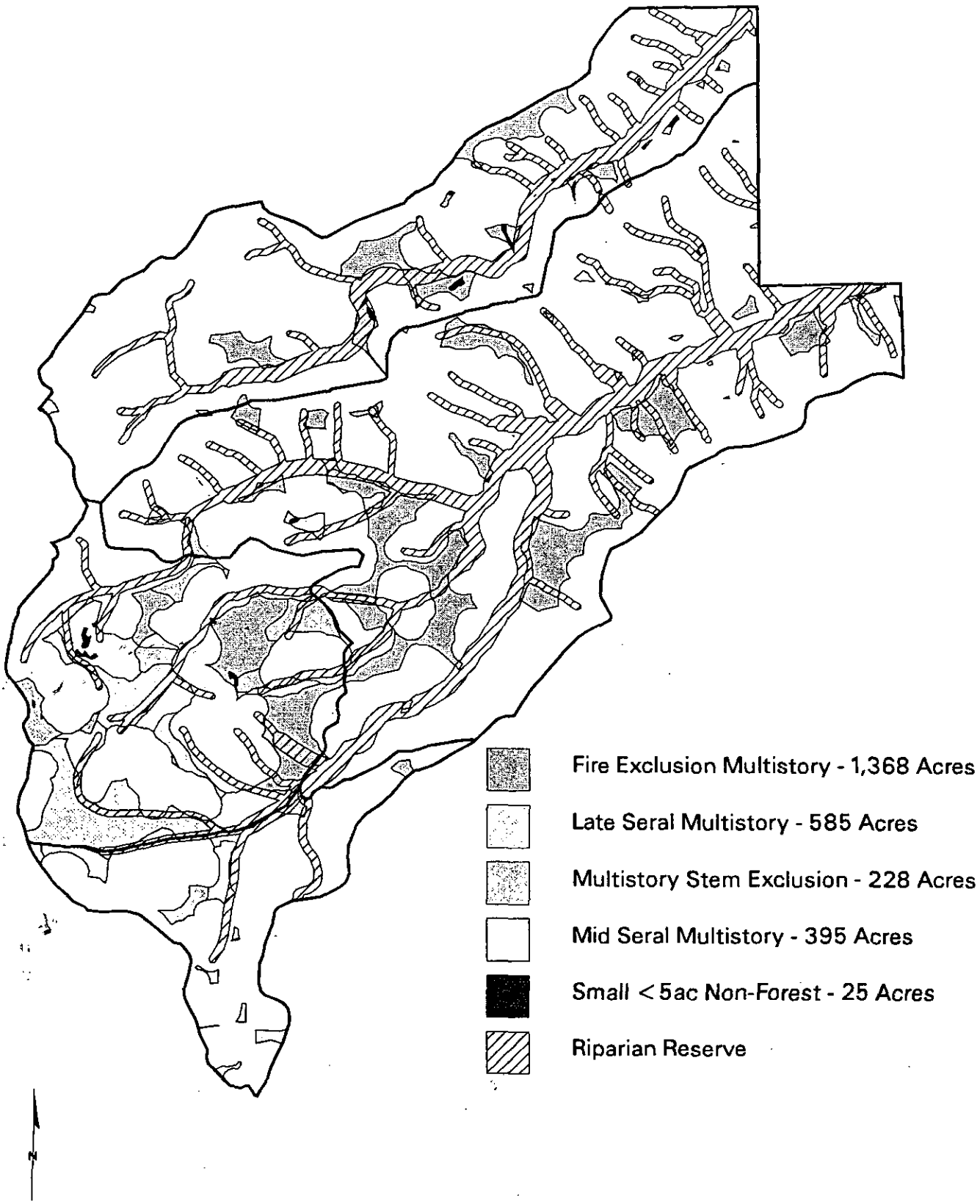
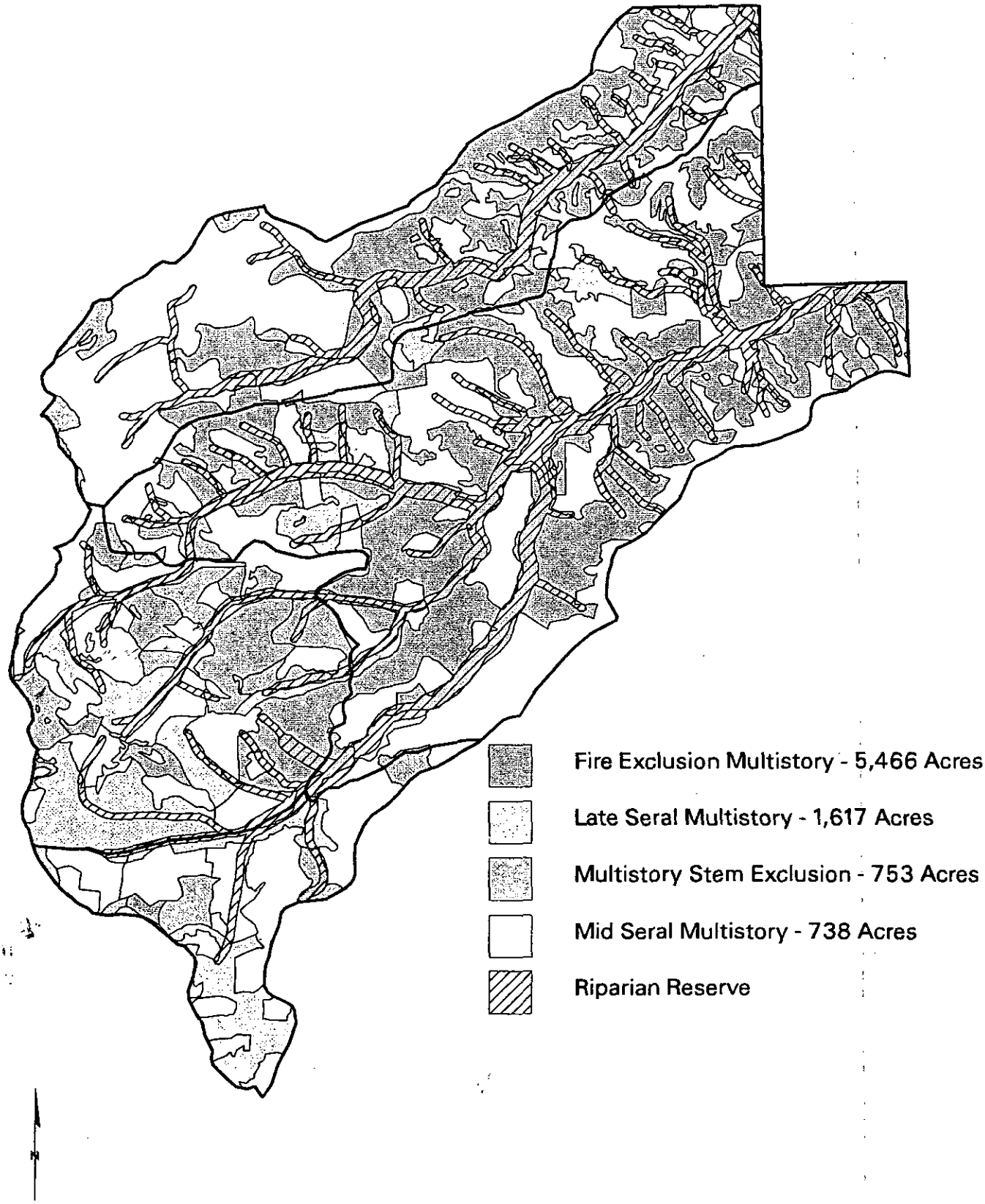


Figure 3-4

Mature Habitat



Refer to figure 3-3 for riparian reserves and interior habitat. Refer to Figure 3-4 for riparian reserves and existing mature habitat.

North Fork Mill Creek Landscape Unit

Mature Habitat Species:

Vegetation Pattern - The best mature habitat in this LU is located mainly within the riparian areas to the Forest Boundary. The best spotted owl habitat in this LU also happens to be in the riparian areas. The upland areas have had timber harvest activity which has fragmented late seral habitat. Spruce budworm and root rot pockets have created natural openings within these stands. Riparian Reserves provide mature habitat.

Connectivity - There is good connectivity from east to west within the riparian zone. There are connectivity routes to the south on the west edge and one through the middle of the LU. There is no connection to the north as this LU is adjacent to private property that has been harvested. Also to the north the late seral habitat naturally ends the closer to the Columbia River you get. This area transitions into oak woodland habitat.

Human Influences - Timber harvest activities have altered the amount and arrangement of late seral habitat. Roads have also fragmented the habitat. One small campground on the western edge is also located within this LU. This also fragments the habitat.

Big Game Habitat :

Vegetation Pattern - Forage is currently good throughout the LU. Thermal cover is patchy and not well distributed on the west end of the LU. The amount and arrangement of thermal cover is good in the middle to east section of this LU. The western half of the LU contains good calving and fawning habitat.

Connectivity - Big game dispersal is good throughout this LU. There are some narrow corridors adjacent to harvested units and natural grass openings.

Human Influences - High open road densities on the west half of the LU may cause harassment to big game animals. The open road density for the whole LU is 1.67 miles/sq. mile.

Riparian Species:

Vegetation Patterns - Alder is the major riparian vegetation component on the west end of the LU near Gibson Prairie. Conifers become the major component starting at the 1700-662/660 junction and continues down the drainage to within two miles of the LU boundary. At this point hardwoods mainly cottonwoods and maples become the dominant riparian species. More human influenced animal species (ie. raccoons and opossums) can be found on the east end of this LU.

Connectivity - Good dispersal of riparian species can be expected along the North Fork Mill Creek and it's tributaries until the houses start on the east end of the LU. The human presence may disrupt the movement of animal species.

Human Influences - Homes on the east end impact habitat, species present and animal movement. Timber harvest units throughout the LU narrow the riparian corridor.

Snag Dependent Species:

Vegetation Patterns - Most of the timber harvest units meet the 60 percent biological potential for cavity dependent conifer species. Most of the clear cut units lack green tree replacements for future snags. The majority of the snag

habitat is located on the western ¾ths of this LU. The down woody component is generally lacking in timber harvest units.

Connectivity - Currently there is no major disruption in snag habitat in the conifer areas. There may be some disruption in movement in those clear cut units when the snags start to fall.

Human Influences - Regeneration timber harvest activities have impacted both current and future snag/down woody numbers. The numbers are currently low and future recruitment will be slow within these units.

South Fork Mill Creek Landscape Unit

Mature Habitat Species:

Vegetation Patterns - Mature habitat ends near the Forest boundary possibly extending farther east in the riparian zone. The majority of spotted owl habitat is located above Crow Creek Dam to the west. Some fragmentation of late seral habitat has occurred from timber harvest activities. Possible great gray owl habitat may occur on the east edge of this LU.

Connectivity - The east to west dispersal occurs mainly within the riparian zone. The north to south dispersal is possible through one corridor with timber harvest fragmenting some other possible routes. Connectivity ends near the Forest boundary for late seral species.

Human Influence - Timber harvest has fragmented the late seral habitat which also decreases the amount on interior habitat available. Increased water flows in the South Fork from the Dog River pipe have probably helped the riparian area grow into late seral habitat faster. The Crow Creek Reservoir is home to ospreys, ducks and other water species. Fast water habitat has been changed to slow water habitat.

Big game Species:

Vegetation Pattern - The west end of the LU has good thermal cover and the timber harvest units supply forage. The east end transitions into oak woodlands and the winter range line starts at about the 3000 foot elevation line. Forage is not limited at this time throughout the LU. Thermal cover is well dispersed in the west end and located in riparian zones plus north aspects in the east end.

Connectivity - There is good dispersal east to west mainly in the riparian zones and north to south via drainages plus unharvested timber stands. A major elk/deer migration route occurs in the South Fork Mill Creek drainage. This route crosses the Stroud LU and goes through the Rural LU.

Human Influence - The majority of this LU is a security area for big game because of The Dalles Watershed. Leased hunting on the private lands adjacent The Dalles Watershed possibly has contributed to increase the size of the security area. A concern has been raised that this security area has contributed to increased damage complaints on private property. Limited entry elk hunts (both archery and rifle) occur yearly within The Dalles Watershed to help reduce elk numbers and allow some recreation in this watershed. The cougar population is increasing and damage complaints have started to increase in the east end of this LU (Jim Torland, ODFW, verbal communication).

Riparian Species:

Vegetation Patterns - Crow, Alder and South Fork Mill Creeks have had timber harvest activities which have narrowed (to approximately 50 feet in some areas)the riparian zones adjacent to the harvest units. The riparian zones are in relatively good condition with adequate amounts of large woody material and relatively healthy trees. A Copes salamander has been found in Crow Creek and suspected in the South Fork Mill Creek. The riparian vegetation changes from conifers on the west end to alders, vine maple and cottonwood on the east end.

Connectivity - The Crow Creek Dam and the falls on the South Fork Mill Creek may slow movement of amphibians within the drainage. There is good connectivity for the majority of riparian species.

Human Influences - This LU has the Crow Creek Dam which has made a lake that attracts waterfowl and ospreys. Timber harvest units have narrowed the riparian zone in some places. The Dog River Aqueduct has increased the volume of water flowing down South Fork Mill Creek. This is probably a benefit to the faster vegetation growth within the South Fork. There are several roads with culverts that run through the riparian areas. At least one of these culverts is being replaced with a bridge. These roads may slow movement of some amphibian species. There is a mobile home park near the junction of the South Fork and North Fork Mill Creeks. There is virtually no riparian vegetation remaining in this area. Cattle are grazed on private ground within this LU. Grazing can alter riparian vegetation. There is no specific evidence that this has happened in this LU at this time.

Snag Dependent Species:

Vegetation Patterns - Most of the timber harvest units meet the 60 percent biological potential for cavity dependent species. Most of the clear cut units lack green tree replacements for future snags. The majority of the snag habitat is located on the western ¾ of this LU. The down woody component is generally lacking in timber harvest units.

Connectivity - Currently there is no major disruption in snag habitat in the confer areas. There may be some disruption in movement in those clear cut units when the snags start to fall.

Human Influences - The timber harvest activities have impacted both current and future snag/down woody numbers. The numbers are currently low and future recruitment will be slow within previously harvested clearcut areas. However, recruitment should be problem in partial cut and no cut areas.

Mill Creek Buttes Landscape Unit

Mature habitat Species :

Vegetation Pattern - This landscape Unit (LU) is wholly within the Surveyor's Ridge LSR. The reduction of fire frequency in this LU has allowed the vegetation pattern to shift towards a multi-canopy stands with and increase in mature habitat. Very little fragmentation has occurred within this LU. Only a small percentage (7%) of the LU has had harvest activities. This leads to the highest percent (42% within LU) of interior habitat within the watershed. This LU appears to be functioning as a refugia source for high elevation stands of late seral species. However, high elevation and tree species mix does is not the best spotted owl habitat.

Connectivity - Internal connection still exists across this LU and between it and Stroud LU. The connection to Surveyor's Ridge LU (referenced in the Surveyors Ridge LSRA, 1997) has been altered because of pockets of mortality due to spruce budworm attacks. This altered connection may affect smaller animals, some plants and fungi species. Grand fir is the most common tree species affected by this mortality. This LU also contains many rock outcrops and talus slopes, but we believe these are too small and well scattered enough to stop movement through the landscape. The Open-Intolerant-Multistory and Fire-Exclusion-Multistory stands may not have been dense enough to provide the type of habitat that has existed for the last fifty years. This is especially true for the vegetation in Fire Group 3 located on south slopes and the lower elevations of this LU. The primary connection with Stroud LU is provided by the Riparian Reserve along an unnamed tributary to the South Fork Mill Creek. This Tributary also contains the gauging station and outflow point for the Dog River Aqueduct. The primary connections with the South Fork Mill LU and the North Fork Mill LU are the Riparian Reserves along perennial streams. Past timber harvest activities has limited connection via narrow corridors to the North Fork Mill LU.

Human Influences - Very little management activity has occurred in this LU. Only (7.24%) percent of the LU has been previously harvested. The road density (1.38 miles/square mile) is quite low. One radio relay unit is located on Mill Creek Butte. Limited access because of the Dalles Watershed has created security areas for wildlife.

Big Game Habitat:

Vegetation Pattern - The majority of this LU is thermal cover. Only a small percentage of this LU is forage habitat and this is located on the edges of the LU. The forage areas are mainly previously harvested timber stands located in the Crow Creek drainage. A few natural grass openings occur near the buttes. These also supply some forage value. Several elk wallows exist on the eastern edge of this LU in the headwaters of Alder Creek.

Connectivity - Since Mill Creek Buttes LU is the highest elevation LU within this watershed, it is mainly used as summer range. The animals that use this area migrate down to lower terrain during the winter. This LU is not used as a major travel or migration corridor for deer and elk.

Human Influences - This area has low road densities and limited access because it is in the Dalles Watershed. Because of the limited human disturbance, this LU acts as a security area for deer and elk. This is especially true where this LU adjoins the Surveyor's Ridge LU on the west side. A limited entry (25 tags each) elk hunt for archery and rifle hunters occurs in the Dalles Watershed annually.

Riparian Species:

Vegetation Patterns - This LU is the headwaters for South Fork Mill Creek, Crow Creek and Alder Creek. The riparian zones are in relatively good condition. The upper end of Crow Creek has had some timber harvest activity. Approximately 100 feet buffers remain along the riparian zone next to the timber harvest areas. Large woody material is present in all these headwater streams. The South Fork Mill Creek had been cleared of large woody up to 1987.

Connectivity - Since this LU is the headwaters for Crow, Alder and the South Fork Mill Creeks, the riparian habitat begins in this LU and goes east. There are some natural breaks in connectivity within this LU between these headwater streams.

Human Influences - The Stroud Aqueduct flows into the South Fork Mill Creek. This increases the summer flow by at least 100 percent. This may allow the trees to become larger in both diameter and height then the other tributaries.

Snag Dependent Species:

Vegetation Pattern - The majority of this LU has snag levels at the 100 percent biological potential. Recent spruce budworm attacks have created a number of snags. These are mainly grand fir with some Douglas fir. Root rot pockets are also present which contributes to short term snags and down woody. The timber harvest units have some snags which average 60 percent biological potential. The majority of the clear cut units do not have green tree replacements trees for future snags. The shelterwood units do have green tree replacements for snags.

Connectivity - The arrangement of snags is very good through this LU. There are a only a few gaps with some in clearcuts and the remaining in natural openings.

Human Influences - The timber harvest activity along with road side hazard tree removal have had the largest influence on snag numbers. The suppression of fires has probably increased the number of snags over historical numbers. Within the Fire Group 3 areas of this LU more small diameter trees exist because of the lack of fire.

Stroud Landscape Unit

Mature Habitat Species:

Vegetation pattern - This LU has been fragmented from past timber harvest activities. The remaining unharvested stands are functioning as late seral habitat. There is very little interior habitat available within this LU. This LU has some of the best potential spotted owl habitat because of its elevation and tree species composition (100+ year old trees). Emphasis on spotted owls here because entire LU is in the Surveyors Ridge LSR.

Connectivity - The remaining late seral habitat is located in narrow corridors and along riparian areas. Some of these stands are showing signs of high tree mortality from a variety of causes such as root rot, insects, diseases and old age. These stands may not be functioning as connectivity routes for very many more years (less than 50 years).

Human Influence - We have already mentioned the timber harvest activities within this LU. The road density is 3.95 miles per square mile. Very little interior habitat remains because of the fragmentation from past timber harvest.

Big Game Habitat:

Vegetation Patterns - The mosaic of harvest units has created a cover/forage ratio of 71% cover/29% forage. This LU is being heavily utilized by deer/elk/bear and probably cougars. This LU is within the summer range area for deer and elk. The cover areas are thermal with some optimal thermal is present. The current forage areas will grow into cover within 20 years. Some additional forage will be created as late seral vegetation matures and openings in the canopy are created. This will take place over a much longer time period (100-200 years)

Connectivity - Good travel corridors exist with a minimum width of 600 feet between harvest units. Animals can travel both north/south and east/west within these corridors. A major elk and deer migration route goes along the South Fork Mill Creek through this LU.

Human Influences - Timber harvest units have created forage areas which are ideal for deer and elk. This LU is wholly within The Dalles Watershed which is restricted to limited entry by the public. This closure has created a security area for big game animals.

Riparian Species:

Vegetation Pattern - The South Fork Mill Creek and a major unnamed tributary of the South Fork contain the best riparian habitat within this LU. Very little disturbance has taken place in or near these riparian zones. Numerous springs occur within the upland areas of this LU.

Connectivity - There is potential movement by riparian species in all directions within this LU. The upland springs connect to the South Fork Mill Creek and it's tributaries. There is usually a break in connectivity in the uplands where these various riparian areas begin and this is true in this LU.

Human Influence - Timber harvest units have narrowed the riparian areas in some areas. The effectiveness of the narrow riparian corridors is further reduced by the climatic response on these edges. Wind and temperature fluctuations are greatest on the edge of these riparian corridors. The Dog River pipe flows into the South Fork Mill Creek within this LU. This has increased the amount of water flowing down the South Fork Mill Creek. It is speculated that the trees in the riparian zone may be larger in diameter and height because of this increased water.

Snag Dependent Species:

Vegetation Patterns - The snag numbers exceed the 100% biological potential for the unharvested areas (71% of the LU). The snag numbers meet the 40-60% biological potential in most of the harvested units. The regeneration harvest

units lack green tree replacements for future snags. The amount of down woody material is highest in unharvested stands and lowest in harvested units.

Connectivity - There is good dispersal opportunities for snag dependent species. Currently, no large areas are devoid of snags. In approximately 20-50 years, most of the regeneration harvest units will be devoid of snags as the current ones fall. This will create 20-40 acre gaps in the landscape. The riparian areas should still function as dispersal corridors throughout time unless a catastrophic event (such as a fire or wind) occurs.

Human Influences - Timber harvest activities have altered the snag creating cycle by reducing potential numbers of snags. We have created snags by blasting the tops out of green trees in some of these harvested units. The lack of green tree replacements within regeneration harvest units will have the greatest impact on future snag development. These units could be devoid of snags for 20-150 years.

Rural Landscape Unit

Big Game Species:

Vegetation Patterns - The oak woodlands and the riparian zone supply some cover value. There are very few conifer cover patches located in this LU. Forage can be found mainly in the brush/oak woodland and agriculture fields.

Connectivity - This LU connects with The Dalles Watershed on the west. The cover connectivity is mainly through oak woodland. There is a dispersal route north and south through this oak woodland habitat.

Human Influences - The historical forage areas have been altered by agriculture fields and residential areas. This LU is winter range for deer and elk. Damage complaints are increasing as more development occurs. This LU has the highest potential for human/wildlife conflicts within the watershed.

Riparian Species:

Vegetation Patterns - The riparian vegetation is in narrow corridors along the creek. This is being maintained this way by human residences and agricultural fields. Much of the slow water beaver habitat has been lost within this LU. There are increased numbers of human associated species (ie. Raccoons, opossums and skunks) within this LU.

Connectivity - This LU connects with the relatively good riparian areas (North and South Fork Mill Creek) to the west and the very poor riparian area to the east (The Dalles LU).

Human Influences - Homes and agriculture are the major human influences in this LU. Along with this human presence comes such things as bird houses, cat and dog food containers, garbage. This attracts species such as opossums, skunks and raccoons. Riparian species such as beavers are trapped as nuisance animals because they flood fields and change the stream channel.

Snag Dependent Species:

Vegetation Pattern - The snag habitat is located mainly in the riparian zone and oak woodlands. Lewis's woodpeckers are common in this LU and oak woodland dependent.

Connectivity - Good connectivity currently exists through the oak woodlands to the north, south and west. The riparian area also supplies a good connectivity route to the west and a marginal connection to the east.
Human Influences - The clearing of riparian and oak woodlands for agricultural and residential needs. This remains the number one concern for snag dependent species.

The Dalles Landscape Unit

Big Game Species :

Vegetation Patterns - The only habitat is located on the west edge of this LU. This habitat is only marginally effective in supporting big game. Numerous houses and agricultural activity occur in this area. The remaining area of the LU is not habitat.

Connectivity - There is limited connection to the west, north and south. All the habitat is oak woodland.

Human Influences - This LU has the highest amount of human use. This is where the city limits of The Dalles starts. Wildlife damage complaints are common in this LU.

Riparian Species:

Vegetation Pattern - Some narrow bands exist on the west edge of this LU. The city limits portion has very little riparian vegetation. The creek goes through a tunnel the last half mile to the Columbia River.

Connectivity - There is minimal connection to the west.

Human Influences - Numerous people inhabit this LU. Consequently, very little riparian habitat remains.

Snag Dependent Species:

Vegetation Pattern - Some habitat remains along the riparian area and in the oak woodland portion of this LU.

Connectivity - There is limited connection to the west, north and south.

Human Influences - The high number of residences greatly reduces the number of snags which are allowed to remain.

Table III - 3 -refer to figures 1-2, 3-3, 3-4. This table reflects the narrative of Chapter III Question 2 *in table form.*

NORTH FORK LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	Mature conifer habitat is located mainly in the riparian areas within NF boundary. This is also some of the best spotted owl habitat in LU> in upper elevations, extensive shelterwood and clearcut harvest has reduced effective late seral structure. Small natural openings have been created by spruce budworm and root rots.	Riparian zone provides good east-west connectivity. Connectivity to south is limited. There is basically no connectivity to the north due to timber harvest on private lands and transition to oak woodland types.	Timber harvest and road construction has significantly reduced late seral habitat in the western half of LU.
BIG GAME SPECIES	Good forage exists throughout LU. Thermal cover is limited in west half of LU, but adequate in the remainder. West half contains good calving and fawning habitat.	Dispersal habitat is adequate throughout LU. Timber harvest and natural openings have created some narrow corridors.	Open road densities are high, and may result in harassment.
RIPARIAN SPECIES	Streams and wetlands near Gibson Prairie have extensive alder communities. Conifers dominate the remainder ot the riparian areas within the NF boundary. Below the NF boundary, cottonwood and maple become important.	Good dispersal habitat exists west of residential developments. Residential developments may disrupt wildlife movements.	East of the NF boundary, human developments have impacted habitats, species occurrence and dispersal patterns. Timber harvest has narrowed the riparian corridor in various portions of the LU within the NF. Species tolerant of human activities (raccoons and opossums) become common on private lands.
SNAG DEPENDENT SPECIES	Majority of snag habitat is located in western 3/4 of LU. Harvest units generally meet 60% biological potential for cavity-dependent species, but typically lack green tree replacements and down wood.	Within conifer areas, snags are well-distributed. Connectivity may become a problem as snags fall in harvested areas, and no replacements are available.	Timber harvest has reduced current and future snags and down wood.

SOUTH FORK LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	Mature forest habitat is found mainly within the NF, and to a very limited extent in the riparian area outside the NF boundary. Majority of spotted owl habitat is west of Crow Creek Dam. This portion is somewhat fragmented by clearcutting. Great gray owl habitat may occur on eastern edge of LU.	East-west connectivity is provided within riparian zone of S. Fk., and ends at the NF boundary. North-south connectivity is limited (by timber harvest) to one corridor.	Interior habitat is very scarce, due to both natural and human-caused fragmentation. Increased summer flows from Dog R. aqueduct may have increased tree growth in the upper riparian area of S. Fk. Crow Cr. Reservoir has created habitat for ospreys, ducks, and other open-water species.
BIG GAME SPECIES	Both cover and forage are abundant. Thermal cover is extensive in the western portion, and occurs within the riparian zone and on north slopes in the eastern portion. Forage is supplied both from clearcuts and natural openings. Areas below 3000′ are used as winter range.	Good dispersal habitat exists in both north-south and east-west directions, in riparian areas and undisturbed forest stands. The S. Fk. drainage is a major deer/elk migration route that connects the Dog R. and Rural LUs.	Closure of The Dalles Watershed makes this a security area for wildlife. This may contribute to an increase in wildlife damage complaints from adjacent landowners to the east. A limited entry hunt occurs annually. The cougar population appears to be increasing, along with private landowners= concerns.
RIPARIAN SPECIES	In general riparian areas are in good condition with adequate large wood and forest cover. Timber harvest in Crow Cr., Alder Cr.and S. Fk. has narrowed the riparian buffer to as little as 50′ in some areas. In the vicinity of Crow Cr. Dam, hardwoods become an important component of the riparian vegetation. Cope=s salamander has been sighted in Crow Cr., and is suspected to occur in the S. Fk.	Dispersal of most riparian species is adequately provided for. Crow Cr. Dam and a falls on the S. Fk. may inhibit the movement of amphibians.	The function of the riparian zone has been affected by timber harvest (narrowing the buffer), cattle grazing (on private lands), developments, and road crossings/culverts in certain locations. Crow Creek Reservoir has created habitat for osprey and other waterfowl. Growth of riparian vegetation in the upper S. Fk. has likely been enhanced by diversion of summer flows from Dog R.

SNAG DEPEN-DENT SPECIES	Majority of snag habitat is located in western 3/4 of LU. Harvest units generally meet 60% biological potential for cavity-dependent species, but typically lack green tree replacements and down wood.	Within conifer areas, snags are well-distributed. Connectivity may become a problem as snags fall in harvested areas, and no replacements are available.	Timber harvest has reduced current and future snags and down wood.

MILL CREEK BUTTES LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	LU is within Surveyor=s Ridge LSR. Has a high proportion of unfragmented late seral stands with interior habitat conditions; probably functions as refuge for late seral species. However elevation and tree species mix not the best spotted owl habitat.	Adequate connectivity within this LU and into Dog River and S. Fork LUs thru riparian areas. Connectivity to N. Fork LU is narrow, due to timber harvest. Connectivity toward Surveyor=s Ridge affected by pockets of mortality due to insects (affects mostly smaller animals). Scattered rock/talus openings probably don=t significantly affect connectivity.	LU has very low levels of timber harvest and road building; impacts to mature habitat species have probably been minimal. Closure of the Dalles Watershed has created security areas for wildlife in general.
BIG GAME SPECIES	Majority of LU is thermal cover, forage is limited except in scattered grassy openings and in harvested areas near the perimeter. Elk wallows occur on east edge of LU in Alder Cr. headwaters.	Mainly summer range, not extensively used as migration corridor for deer and elk.	Low road densities and closure of The Dalles Watershed make this LU a security area for deer and elk. Limited entry hunt for deer and elk (25 tags each) occurs annually.
RIPARIAN SPECIES	In general riparian zones are in good condition and have adequate large wood. S. Fk. of Mill Cr. had large wood removed until 1987.	Connectivity is virtually continuous throughout the riparian zones within this LU.	Dog R. aqueduct flows into S. Fk. Mill Cr, and increases summer flows by 100% or more. Larger tree sizes within the riparian zone appear to have resulted from the additional moisture.
SNAG DEPENDENT SPECIES	Most of LU is at 100% of biological potential for snags. Insect activity continues to create more snags in grand fir and Douglas-fir. Harvested areas appear to average 60% of biological potential, and green tree replacements are lacking in clearcuts.	Snags are well-distributed throughout LU except in some clearcuts and natural openings.	Timber harvest and hazard tree removal have decreased snag numbers in clearcuts and along roads. Fire exclusion in FRG 3 areas appears to have resulted in higher numbers of smaller snags than would be the case under a natural fire regime.

STROUD LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	Highly fragmented late seral habitat. Little if any interior habitat remains. Good potential habitat for spotted owl in future.	Provided through very narrow corridors between harvest units, and along streams. There is high mortality in these strips, and they may not continue to function beyond 50 years or so.	Extensive timber harvest and road building has caused fragmentation and loss of interior habitat.
BIG GAME SPECIES	Cover/forage ratio = 71/29. Cover is mostly thermal, some optimal thermal. Forage will decline significantly in next 20 yrs. as harvest units become reforested. Heavy use by deer, elk, bear and possibly cougar. Summer range for deer and elk.	Good travel corridors between harvest units, providing connectivity in all directions.	Timber harvest has temporarily increased forage. Closure of The Dalles Watershed creates a security area for wildlife.
RIPARIAN SPECIES	High quality undisturbed riparian habitat exists along S. Fk. Mill Cr. and its unnamed trib. Springs are abundant in upland areas.	There is potential movement in all directions. Headwaters have numerous springs.	Effectiveness of riparian corridors has been compromised by clearcutting and subsequent windthrow. Water from Dog R. aqueduct flowing into S. Fk. Mill Cr. may have resulted in increased tree sizes in riparian zone.
SNAG DEPENDENT SPECIES	Snags are >100% biological potential in unharvested areas (71% of the LU), and 40-60% in harvested areas. Clearcuts lack green tree replacements, and may have inadequate levels of down wood.	Currently snags are well-distributed within the LU. In 20-50 years, harvested areas will lack snags (lack of green tree replacements), creating 20-40 ac. gaps in snag distribution.	Timber harvest has reduced the potential snag numbers for the future, but currently snags are adequately distributed.

RURAL LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	Significant amounts of mature conifer habitat are not present in this LU; the potential vegetation mostly consists of open pine-oak woodlands, and grassy openings.	N/A	N/A
BIG GAME SPECIES	Cover exists in oak woodlands and riparian zone; conifer stands are very limited. Forage exists in brushy oak patches, grassy openings and agricultural fields.	Oak woodlands on west end provide connectivity into The Dalles Watershed, and also to north and south.	The LU is within winter range for deer and elk. Agriculture and development has altered forage patterns, and increased conflicts between humans and wildlife.
RIPARIAN SPECIES	Streamside riparian vegetation is a very narrow corridor, due to development and agriculture. Much of slow water habitat for beavers has been lost.	Functions as a transition between good-condition riparian areas to west, and poor-condition areas to the east.	Human-associated species (raccoons, skunks, opossums) have increased in agricultural and residential areas. Trapping has virtually eliminated beavers.
SNAG DEPENDENT SPECIES	Snag habitat is confined to oak patches and riparian area. Lewis= woodpeckers are common, and dependent on oak habitat.	Oak woodlands provide good connectivity of snag habitat throughout LU and to the north, south and west. Riparian zone connects to snag habitat to the west, but snags are lacking in The Dalles LU to the east.	Clearing for residential development and agriculture has significantly reduced snag habitat.

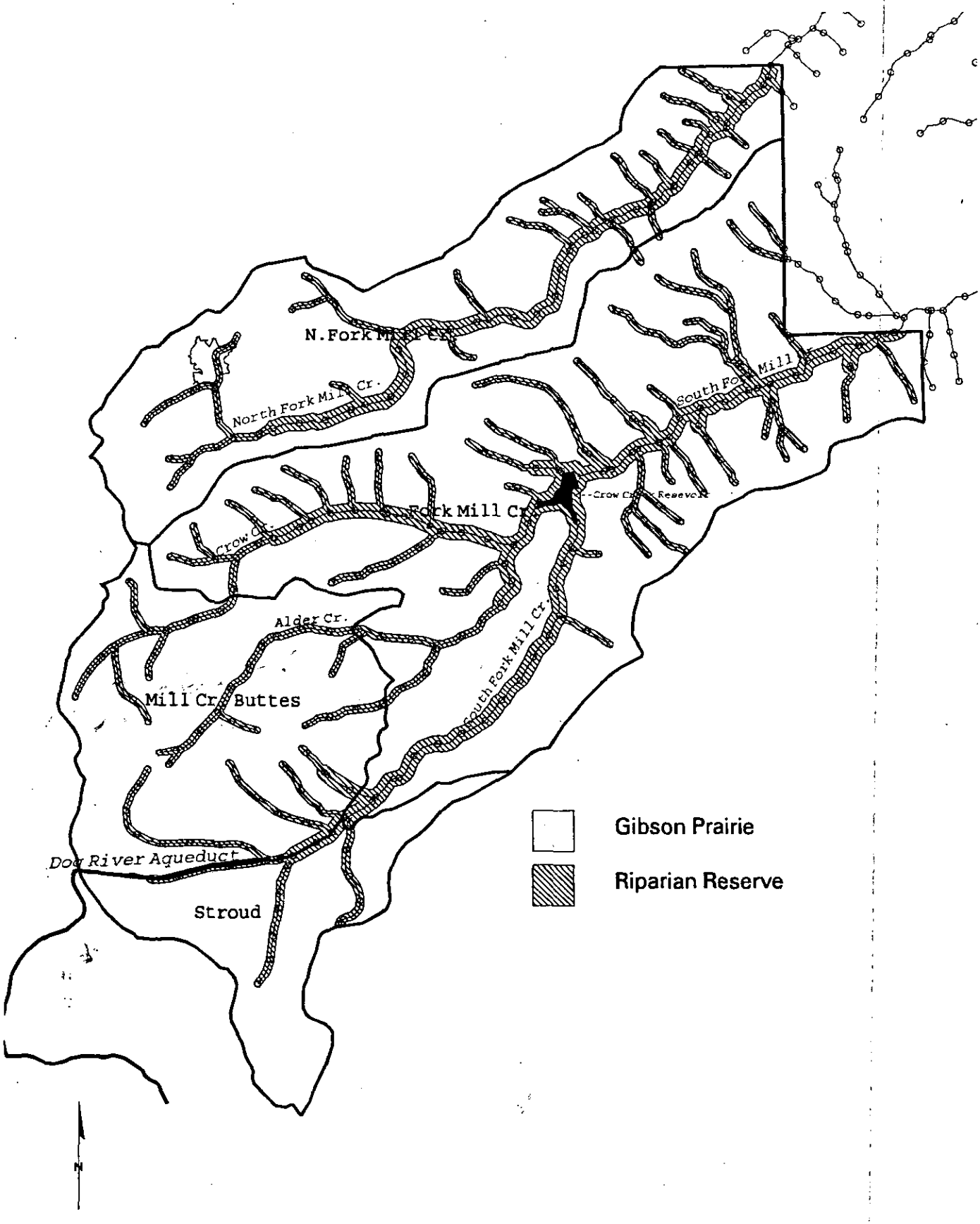
THE DALLES LANDSCAPE UNIT

	VEGETATION PATTERNS	CONNECTIVITY	HUMAN INFLUENCES
MATURE HABITAT SPECIES	Significant amounts of mature conifer habitat are not present in this LU; the potential vegetation mostly consists of open pine-oak woodlands, and grassy openings.	N/A	N/A
BIG GAME SPECIES	Habitat is restricted to west edge of LU, and is only marginally effective.	Limited oak woodland habitat connections to west, north and south.	Landscape is highly altered by human development. Human/wildlife conflicts are common.
RIPARIAN SPECIES	Riparian habitat is limited to very narrow bands in western edge of LU. Within the City of The Dalles, habitat is virtually absent. Mill Creek flows through a half-mile tunnel prior to emptying into the Columbia River.	Minimal connectivity to the west.	Riparian habitat is very limited, due to human developments.
SNAG DEPENDENT SPECIES	A small amount of snag habitat exists in riparian area and oak patches.	Minimal connectivity to west, north and south.	Few snags are allowed to remain, due to risks to human-built structures.

Note: A general description of the Down Woody Debries information can be found starting on page Ch-III-Q2-1 - Ch-III-Q2-2. Table III-2 shows a comparison between the recommendations from other planning documents. In addition Mill Creek Watershed is listed in the table to show how it would look given the recommendations from the other planning documents. This information only applies to lands in the landscape units within the National Forest Boundary.

Figure 3-5

Gibson Prairie and Riparian Reserves



Chapter III: Question 3: How have human influences changed the hydrological process?

Figure 3-5 is only for reference and the location of specific sites.

North Fork Mill LU

Grazing, timber harvest, and residential development has all contributed to some changes in the hydrologic processes in the North Fork Mill Creek.

Most of the timber harvest has been in the uplands but several units have narrowed or removed the riparian vegetation, potentially increasing summer stream temperatures. Slightly more than 5% of this landscape unit has been harvested. One of the largest concentrations of harvest activity is associated with the Schoolmarm Fire, located on private land, which happened in 1967 ao private land. Numerous roads were constructed which crossed intermittent and ephemeral draws, and nearly all of the commercially valuable wood was removed from the site. Due to a loss of root strength and inadequately designed crossings, several small debris torrents originating in the clearcuts and at road crossings are washing large volumes of fine sediment into the North Fork. Vegetation recovery of the area is slow and it is expected that these debris torrents will continue to happen.

Timber harvest and grazing have contributed to the degradation of Gibson Prairie (refer to figure 3-5) . Cows have kept riparian grasses short and have physically altered the stream banks. The ephemeral streams within the meadow complex are actively downcutting which has resulted in a lowered water table, effectively draining the meadow. Timber harvest has removed many of the large trees surrounding the meadow and within the past 5 years riparian alder patches have been narrowed through mechanical means. There is some compaction in the meadow due to equipment operation and wheel tracks are beginning to rill and gully contributing fine sediments downstream. The compaction is also reducing the water holding capacity of this meadow.

Riparian vegetation in the upper end of this creek includes alder thickets several acres in size. An unusual patch of large diameter cottonwood and aspen can be found on one tributary. This small patch, about one half acre in size contains several trees of each species greater than 23 inches DBH. The aspen colony appears to be struggling as there are few young trees.

Downstream in the drainage, on private land, there are several houses built in the riparian area. Most are built on the opposite side of NF Mill Creek from the county road and require access across the creek. The crossings appear to be poorly designed and many washed out in the 1996 flood. These home sites have been developed in the floodplain which reduces the effectiveness of a floodplain, reduces the shade and large wood that if riparian area can contribute to stream, and increase the economic impact of floods

South Fork Mill LU

The greatest human influence in this landscape unit is the Crow Creek Reservoir which captures and stores the water from Crow Creek, Alder Creek, and South Fork of Mill Creek as supplemented by Dog River. This structure has changed the seasonal high and low flows of South Fork Mill Creek to a more constant discharge flow regime. The natural flushing of sediments that occurs in an unaltered stream does not occur as often in this stream. Chemically, Dog River has reduced the phosphate levels in this drainage. Additionally, until 1984, copper sulfate was used to treat algal blooms in the reservoir. It is assumed that downstream aquatic life was adversely impacted.

In the 1800's a mill was located near the site of the reservoir. Cedar was harvested from the riparian areas and floated downstream. To facilitate this operation, log jams and large wood were removed from South Fork Mill, Alder, and Crow Creeks. This practice was continued on Mill Creek until the 1980's presumably to keep large wood from floating down into the reservoir. Some of the downcutting in South Fork Mill Creek can be attributed to this.

The South Fork of Mill Creek below the Crow Creek Dam is more stable and not as disturbed by human activity. This portion of the Mill Creek watershed contributes to the municipal water supply for the City of The Dalles and has

restricted access. There is a culvert below the reservoir, however, that washed out in 1995, 1996, and in 1997, and contributed sediment to South Fork Mill Creek.
Both the Forest Service and The Dalles have harvested timber in this LU. Approximately 6% of this area has been harvested.

About 2 miles upstream from the confluence with North Fork Mill Creek is the city's water treatment facility (Wicks Treatment plant) which includes a chemical storage area. This complex, as well as several mobile homes at the confluence, are located in the flood plain. The road accessing the treatment plant has reduced the width of the riparian vegetation. At the treatment plant, 6.4 cfs/day is removed from South Fork Mill Creek, treated and piped to the city. Flows in South Fork Mill Creek are significantly reduced for most of the year due to this withdrawal.

One debris flow associated with a clearcut reached the creek.

Stroud LU

The City of The Dalles diverts most or all of the water from Dog River, during much of the year into the South Fork of Mill Creek via a pipeline for its municipal water supply. The Dog River would normally be water that would flow into the Hood River Subbasin. The Dalles was granted the water right for Dog River in 1870. They depend on the low phosphate content of Dog River to modify the water in the Crow Creek Reservoir and reduce algae blooms during the hot summer months. Winter diversions from Dog River are carefully monitored to keep Crow Creek reservoir full but not over flowing. During storm and flood events the Dog River diversion is closed and the high flows from this drainage go to the East Fork Hood River. The Dog River diversion is shut off most years in March and April; during this time the upper reaches of South Fork Mill Creek may go dry. During most of the rest of the year the diversion is open and South Fork Mill Creek has a sustained base flow.

Approximately 29% of this small landscape unit has been harvested and is hydrologically unrecovered; this is the greatest percentage of unrecovered acres in the watershed. Snow can accumulate in the harvested openings more than the surrounding mature forest. During rain or snow events, the melting snow plus the rainfall can result in higher peak flows and flooding. Since this landscape unit lies within the transient snow zone, rain on snow events can occur.

Mill Creek Buttes

The Mill Creek Buttes landscape unit encompasses the headwaters for the South Fork Mill Creek drainage including Crow and Alder Creeks.

Approximately 7% of this landscape unit was harvested between 1960 and the present. Most of the harvest was in the uplands of the Crow Creek drainage, but there are reaches of Crow Creek that have reduced canopy closures due to harvest activity. During the 1800's, cedar was harvested from South Fork Mill, Crow, and Alder Creeks to provide wood for the mill located near the Crow Creek Reservoir. Some stream cleanout probably occurred to facilitate floating the wood down to the mill.

Because this area is part of the municipal watershed for the City of The Dalles water supply, access is limited to administrative access and regulated firewood gathering and hunting.

Rural LU

The rural landscape unit most likely functioned as the area that slowed down and spread out flood waters resulting in lower peak flows but longer flood duration. Much of the flood plain and riparian vegetation has been lost or greatly modified due to development and agriculture. Mill Creek channel has been narrowed and straightened to accommodate road and bridge construction as well as houses and storage buildings. Riparian vegetation has been changed in many reaches from maples, alder, and conifers with a brush component to irrigated pastures and orchards. Slow water habitat such as pools and marshy areas have been greatly reduced resulting in loss of within

channel water storage as well as a reduction in associated wildlife such as beaver, ducks, and herons. Runoff from developed lands has added agricultural chemicals, livestock and human waste, and petroleum contaminants to the creek.

The economic loss resulting from flood events has increased because of the value of the homes, crops, road, bridges and other structures built in the floodplain that are susceptible to flood damage. Measures taken upstream to protect properties, such as berming and rip rapping, can increase the potential for flood damage downstream by increasing both velocity and volume of water delivered by the creek.

The Dalles LU

The greatest change to the hydrologic processes from human influences has occurred within this landscape unit. Buildings, parking lots, and streets have all reduced the ability of this area to absorb and store water. The stream channel itself was re-routed to the west and enters the Columbia River through an 950' long tunnel. It is believed that prior to settlement in the 1800's Mill Creek flowed through a wetland several acres in size adjacent to the Columbia. Growth and development of The Dalles, as well as the need for better access to the Columbia for shipping and transportation led to the wetland being filled. Interstate 84, Union Pacific railroad tracks, and part of the commercial downtown area now occupy the former wetland. Urban development within the rest of this landscape unit has led to the narrowing and straightening of the creek throughout.

Additionally, upstream loss of floodplains has potentially increased the magnitude and frequency of floods. The environmental and economic impacts of floods in this area has changed significantly since the urbanization of the area. Urban runoff including petroleum products, farm and household chemicals, and raw sewage now contaminate flood waters creating health risks to humans during the event and subsequent cleanup. Aquatic organism and terrestrial wildlife can also be adversely impacted. The economic impact of flood events has increased due to homes, businesses and historic structures being located in the former flood plain.

Chapter III: Question 4: Are the recommendations made by the 1995 Access and Travel Management Plan still valid for Mill Creek Watershed?

The table on the next page reflects the analysis done for this watershed, with most information coming from the ATM plan.

EXISTING CONDITION

The watershed team took a hard look at this question. We reviewed each landscape units road system, and how that system functions within the entire watershed (see figure 3-6). However, the focus of our efforts here will be on the road system within the National Forest Boundary. The premise of the watershed team looking at the road system, through the watershed analysis process, was to see how recommendations in the ATM plan (see table III-4) would meet the infrastructure needed to manage the watershed now and in the future. Additionally, the watershed team reviewed the ATM plan to see how the recommendations in the plan would minimize any current erosion of soils, sedimentation of streams, wildlife harassment, or other resource damage that may be occurring. The watershed team then wanted to either validate the ATM plan and make additional recommendations based on new information looked at since 1995, or recommend altering, where it seemed appropriate, a recommendation in the ATM plan that would better meet the current needs of the watershed. The watershed team also evaluated the ATM plan in terms of primary users, expected season of use, appropriate method of closure, issues surrounding the road (e.g.. wildlife, non-use, sediment, needed upgrading), and benefits/costs.

The watershed team did validate that recommendations in the ATM plan, and believe the plan would minimize the erosion of soil, the sedimentation of streams, wildlife harassment, when all the implementation is complete. The Mill Creek Watershed Analysis team does have some minor alterations which have been identified (see table V-4, Recommendations). The ATM did a good job of analyzing the overall use and needs of the transportation system within the watershed. In addition, identification of areas needing more site specific information prior to any implementation of actions was present and thorough. Prior to on the ground activities site specific analysis and review of this document and the ATM plan should be done.

It should be noted the analysis information contained in this document will not change the fact that limited entry via a permit will remain in effect within the boundaries of The Dalles Municipal Watershed.

The only trail in this area used for recreation purposes and addressed in the ATM is trail #451, The North Section Line Trail. The ATM plan addressed that management of this trail should be maintained. The future management of this trail includes the removal of motorized use, but keeping the trail open to the other uses, such as those that currently occur.

Mill Creek Watershed Roads

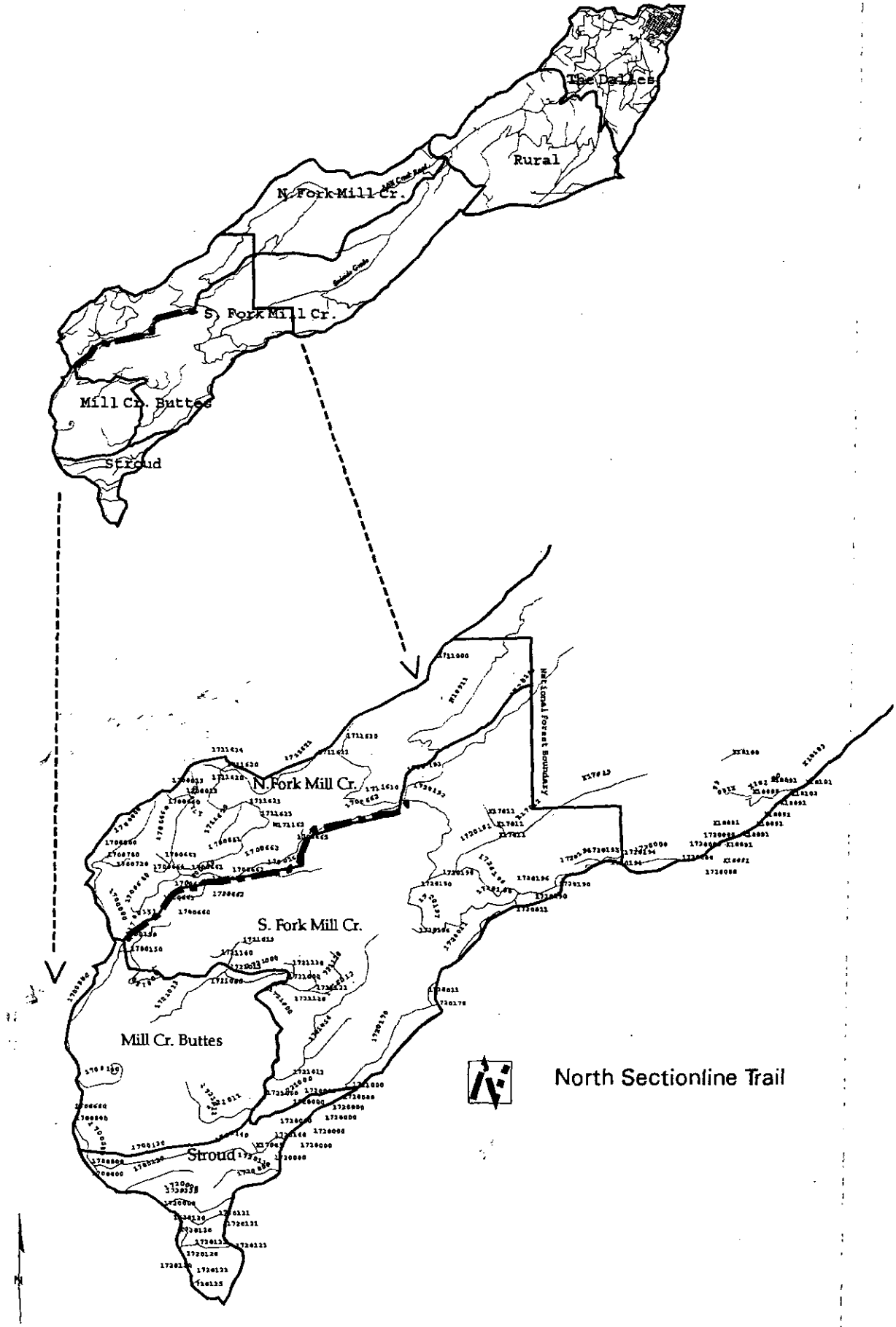


Table III-4 ATM recommendations Mill Creek Watershed. Note: Yes in the closed/oblit. column means obliteration.

Road No.	Surface	Existing Length Open	Existing Length Closed	Future Length Open	Future Length Closed/Oblit.		Closure Device
17	Paved	5.85		5.85			
1700013	Agg	0.75			0.75		Berm
1700120	Agg		0.90		0.90	Yes	Gate TDWS
1700130	Agg		1.25		1.25	Yes	Gate TDWS
1700140	Nat		1.00		1.00		Gate TDWS Radio
1700150	Agg		1.10		1.10	Yes	Gate TDWS
1700151	Agg		0.70		0.70		Gate 150 Rd
1700160	Agg		0.75		0.75	Yes	Gate TDWS
1700161	Agg		1.00		1.00	Yes	Gate TDWS
1700170	Nat		0.40		0.40		Gate TDWS
1700660	Agg	2.30		2.30			
1700661	Nat	1.10			1.10		Berm
1700662	Agg	3.10			3.10		Gate/Seasonal
1700663	Agg	0.30			0.30		Berm
1700664	Agg	0.20			0.20		Berm
1700665	Agg	0.10			0.10		Berm
1700720	Agg	0.40			0.40	Yes	Gate
1700780	Nat	0.10		0.10			Gate-for cattle
1711620	Agg/Nat	1.57		1.57			
1711621	Agg	1.60			1.60		Close 621-end
1711623	Agg	0.20			0.20		Close Berm
1711630	Nat	2.13		2.13			
1720011	Nat		1.90		1.90	Yes	Gate TDWS
1720120	Agg		0.60		0.60	Yes	Gate TDWS
1720121	Agg		0.60		0.60	Yes	Gate 120 Rd
1720123	Agg		0.70		0.70	Yes	Gate 120 Rd
1720125	Agg		0.10		0.10	Yes	Gate 120 Rd
1720130	Agg		0.90		0.90	Yes	Gate TDWS
1720140	Agg		0.90		0.90	Yes	Gate TDWS
1720170	Agg		1.70		1.70	Yes	Gate TDWS
1720190	Agg/Nat		2.90		2.90		Gate TDWS
1720191	Nat		1.50		1.50		Gate 190 Rd
1720192	Nat		1.50		1.50		Gate 190 Rd
1720193	Nat	2.20		2.20			
1720194	Nat		1.00		1.00	Yes	Gate 190 TDWS
1720195	Nat		0.25		0.25	Yes	Gate 190 TDWS
1720196	Agg		2.00		2.00		Gate 190 TDWS
1720197	Agg		0.20		0.20		Gate 190 TDWS
1721	Pave/Agg/Nat		5.90		5.90		Gate TDWS
1721011	Nat		1.00		1.00	Yes	Gate 1721TDWS
1721012	Agg		2.80		2.80		Gate 1721TDWS
1721013	Agg		0.70		0.70		Gate 1721TDWS
1721014	Agg		0.80		0.80	Yes	Gate 1721TDWS
1721120	Agg		1.20		1.20		Gate 1721TDWS
1721121	Agg		0.35		0.35	Yes	Gate 1721TDWS
1721130	Nat		0.25		0.25	Yes	Gate 1721TDWS
1721140	Agg		0.35		0.35	Yes	Gate 1721TDWS
Totals:	59.10 total miles	21.90	37.20	14.15	44.95		

Table III-6 shows what the existing road densities (calculating all existing roads open and closed) within Summer and Winter Range. It should be noted that within The Dalles Watershed all the roads are gated and access to the public is restricted these roads are essentially closed. Therefore, the open road densities (Table III-7) for Summer and Winter Range are not calculated for Mill Creek Buttes, South Fork Mill Creek, and Stroud LU's. North Fork Mill Creek is the only one that open road density measurements have been calculated for.

Table III-5 Existing road densities. All numbers are shown in miles per square mile.

	Mill Creek Buttes	Stroud	North Fork Mill Creek	South Fork Mill Creek
Summer	1.38	3.95	4.14	2.08
Winter	0	0	2.25	2.30

Table III-6 Existing Open Road Densities. All numbers are shown in miles per square mile.

	North Fork Mill Creek
Summer	2.11
Winter	.76

Chapter III: Question 5: Is the tier 1 designation appropriate for the Mill Creek Watershed?

Introduction

In January 1996 the City of The Dalles (City) requested the USDA Forest Service, Region 6 to reclassify The Dalles Municipal Watershed Management Unit from a Tier 1 Key Watershed to a Tier 2 Key Watershed as outlined under the Northwest Forest Plan. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species whereas Tier 2 Key Watersheds are sources of high quality water and may not contain at-risk fish stocks (ROD 1994, page B-18). The City believes the Tier 1 designation shifts protection emphasis from water quality to fish and fish habitat and opens the door for challenges to any facilities upgrades or enhancements the City deems necessary to fully realize their current water rights. At the least, the City feels the Tier 1 designation provides a legal administrative barrier to further development. This document attempts to summarize the affects of changing the designation from a Tier 1 to a Tier 2 Key Watershed but does not try to validate or disprove the above concerns brought forth by the City.

Affected Area

The Dalles Municipal Watershed Management Unit actually encompasses portions of two separate watersheds: Dog River, a tributary to the East Fork Hood River; and South Fork Mill Creek, the major tributary in the Mill Creek watershed. The upper portion of Dog River is classified as a Tier 1 Key Watershed although the lower half (approximately) and the rest of the East Fork Hood River are designated as Matrix. The Tier 1 portion of Dog River is within The Dalles Municipal Watershed Management Unit.

Mill Creek does support both anadromous and resident trout. Steelhead trout are known to ascend Mill Creek and South Fork Mill Creek up to Mill Creek Falls approximately 1.7 miles upstream from the Wicks water treatment plant and 4.0 miles downstream from the Mt. Hood National Forest boundary. Steelhead trout presence/absence has never been confirmed in North Fork Mill Creek, which enters South Fork below Wicks treatment plant, but it is possible steelhead may ascend the North Fork. Resident cutthroat and rainbow trout also reside within the basin. Cutthroat are found primarily above Mill Creek Falls on the South Fork although one was captured below the falls in 1983 by Oregon Department of Fish and Wildlife. Rainbow trout are found below the falls in South Fork Mill Creek and Mill Creek. These fish show traits of introgression with cutthroat trout based on genetic analysis conducted on fish collected in 1993. Presence/absence of resident trout in North Fork Mill Creek is suspected but unconfirmed. Given the current salmonid distribution, rainbow/steelhead trout are the likely salmonid species in North Fork Mill Creek.

Mill Creek Falls is a complete barrier to upstream migrating fish although downstream passage is possible; evidence for this is the genetic introgression mentioned above. Man-made barriers in the watershed include Crow Creek dam on South Fork Mill Creek, located approximately three miles above the falls, and a seasonally dewatered section of South Fork Mill Creek below the Wicks treatment plant.

Dog River contains cutthroat and steelhead trout and coho salmon are known to use habitat near the mouth. Upper limits for the two anadromous species are unknown. Cutthroat trout in upper Dog River are genetically pure based on genetics studies conducted in 1993. Upper limits of these fish are unknown but they do reside above the City diversion point which is unscreened.

Ramifications of Changing From a Tier 1 to Tier 2 Designation

It appears that Mill Creek and upper Dog River was designated a Tier 1 watershed because of cutthroat trout, not due to presence of anadromous steelhead as implied in the letter written by the City in 1996. Fish have never been stocked in South Fork Mill Creek so it is possible these cutthroat are genetically pure. Origins of these cutthroat trout are unclear. Many populations of indigenous trout reside above geologic barriers and have been isolated for generations. However, there is a chance that cutthroat have entered South Fork Mill Creek via the Dog River pipeline, which removes most of the water from upper Dog River. Whether this occurs and if so whether the Dog River population could have "seeded" South Fork Mill Creek above the falls is unknown.

After review of the ROD for the Northwest Forest Plan it is evident there are very few differences in on the ground direction between Tier 1 and Tier 2 Key Watersheds. Tier 1 Key Watersheds are designated with fish and fish habitat as the primary beneficiaries whereas water quality is the major value in a Tier 2 Key Watershed. Both designations will effectively protect both water quality and riparian values through standards and guidelines, and watershed analysis, as outlined in the ROD.

There is also direction to agencies implementing the standards and guidlines of the ROD on how existing laws and regulations relate to the direction of the ROD. It reads as follows (ROD pg. C-1): **Existing Laws and Regulations.**

> Additional direction to management agencies includes, but is not limited to directives, policy, handbooks, manuals, as well as other plans, regulations, laws and treaties. The standards and guildlines presented in this document supersede other direction except treaties, laws, and regulations unless that direction is more restrictive or provides greater benefits to late successional forest related species. None of these standards and guidelines applies where they would require the agencies to take actions for which they do not have authority.

All but one standard and guideline in the ROD are the same regardless of Tier 1 or Tier 2 designation. The only standard that differs is the riparian reserve standard and guideline LH-2 (page C-36); the standard reads:

> Tier 1 Key Watersheds: For hydroelectric and other surface water development proposals, **require** in-stream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. Coordinate this process with the appropriate state agencies. During the relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that **require** flows and habitat conditions that maintain or restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate state agencies.

For all other watersheds (including Tier 2) the standard reads exactly the same except the phrase "give priority emphasis to" is substituted for the first "require" and the phrase "emphasize in-stream" in place of the second "require."

Standard LH-2 appears more stringent for Tier 1 Key Watersheds due to the word "require" but this may depend on whatever improvements/projects the City proposes in the future to realize their full water rights. If the proposed activities can be designed to maintain existing riparian conditions then it shouldn't matter which land designation is in effect because the intent of the Aquatic Conservation Strategy (ACS) will be met. However, if activities degrade existing conditions then the "require" wording for Tier 1 Key Watersheds could be taken verbatim and the activity not allowed or redesigned for lesser impact.

Riparian Reserve standards and guidelines are written to prohibit or regulate activities that would prevent attainment of the ACS objectives. The intent is for the decision maker to make sure proposed activities are consistent with the ACS objectives. Activities that do not maintain existing conditions or lead to improved conditions would not meet the intent of the ACS. The point here is that regardless of the land designation all projects will have to be designed to meet the intent of the ACS.

As long as ACS objectives are met it is unlikely there would be any detrimental impacts to cutthroat trout upstream from Mill Creek Falls or to rainbow/steelhead trout below the falls, regardless of the land designation. North Fork Mill Creek would not be affected by a change in land designations in terms of City activities. Some projects, such as raising the dam height and increasing reservoir storage, could cause short term impacts to cutthroat trout in South Fork Mill Creek due to construction, etc. A project such as this would need to be designed and implemented carefully under either land designation but if the watershed remains a Tier 1 there may be more stringent controls.

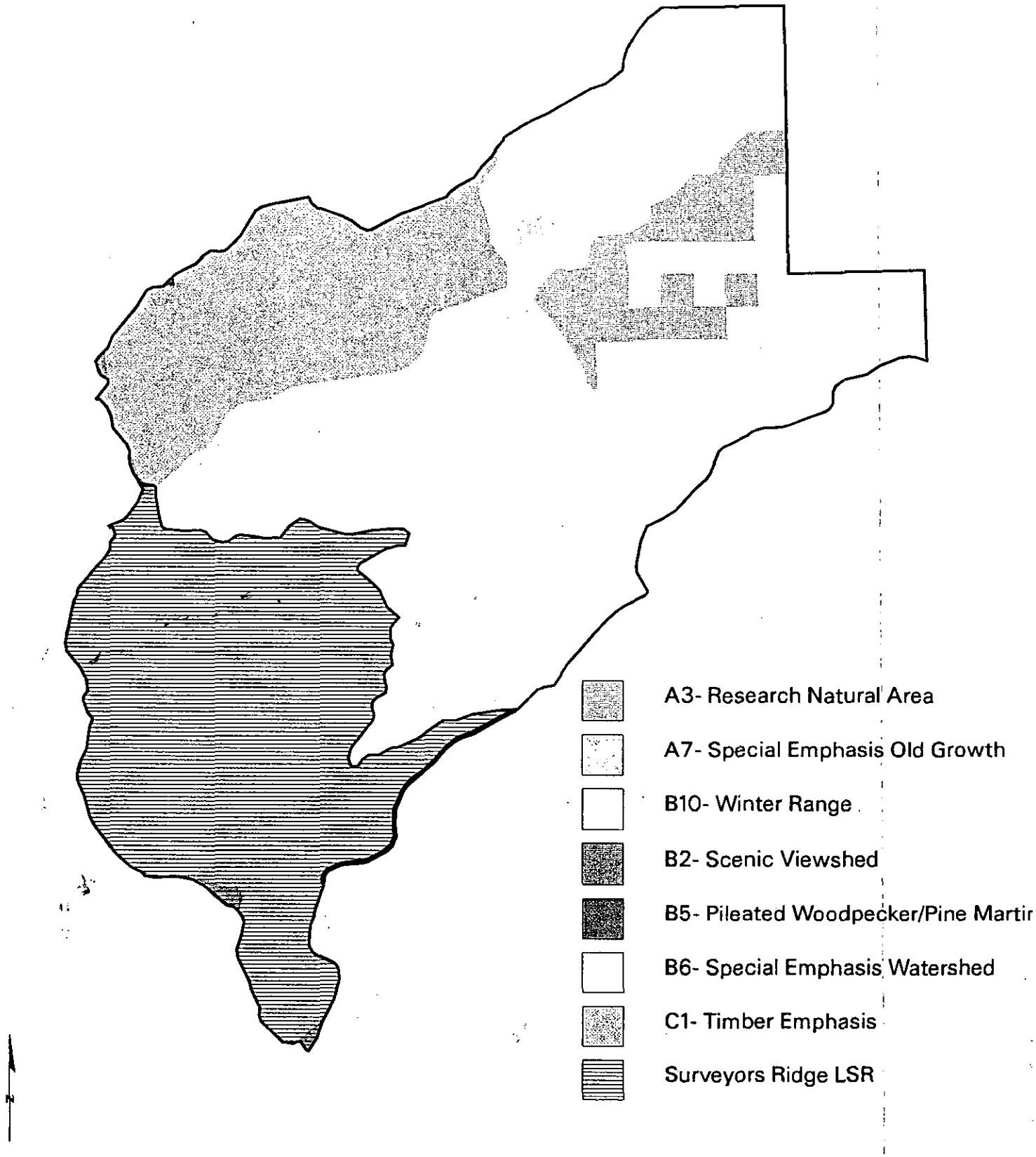
Summary

Management direction for both Tier 1 and Tier 2 Key Watersheds is very similar. All standards and guidelines, the primary vehicle that ensures projects meet the intent of the ACS, are the same except one. The one standard and guideline that differs does deal with hydroelectric and other surface water developments (and thus directly relates to the City of The Dalles concerns) and appears to be more stringent within a Tier 1 Key Watershed because the standard is a requirement as opposed to an emphasis item.

Upon reviewing the above concern, we find that the Tier 1 designation is appropriate for the Mill Creek watershed based on the presence of andromous fish, gentically pure cutthroat trout, and the location of the watershed as part of a system of widely distributed refugia [ROD p.B-18]. The ability to fully develop a valid state water right is not affected by the designation of a Tier 1 or Tier 2 Key watershed. Standards and guidlines do not apply where they would contradict existing law.

Chapter IV

Mt. Hood Land and Resource Plan w/Surveyors Ridge LSR



Chapter IV: Desired Future Condition

Table IV-1 is this narrative in table format. It is provided for ease to the reader in locating specific information.

The Desired Future Conditions (DFC) in this chapter was developed for National Forest lands only. However, the Forest Service may reference this document and work in partnership with the other landowners as the agency works towards the desired future conditions outlined in this chapter. Reference Figure 4-1 for land allocations from the Mt. Hood Land and Resource Management Plan.

North Fork Landscape Unit

There is a unique 44 acre stand of old-growth in this LU designated allocation (A7) Special Emphasis Old-Growth. The DFC for this area is long term maintenance of old-growth forest characteristics. (Note: In order to ensure that the values this type of ecosystem can be maintained, follow-up is needed on the exact location and of the existing structure of the stand itself).

Approximately 1875 acres, (about half of the landscape unit, within the Forest boundary), is designated as Winter Range (B10). The desired condition for this area is thermal and optimal cover maintained on as much area as is capable of producing it in a healthy condition, because, or until, the School Marm Fire area, just off National Forest lands, starts producing thermal cover. Reintroduce fire into areas that fall into Fire Group 2 (fig. 2-5). This will help to keep brush species at a higher quality and more palatable to wildlife. High quality forage is maintained in the natural openings. During critical winter stress periods, interactions between humans and deer/elk are minimized. In addition, winter recreation in the area is restricted to the existing open roads.

There are 2246 acres within the landscape unit with a timber emphasis (C1). The desired conditions within these areas are; (1) Maintain or enhance wetlands (at Gibson Prairie) and hardwood stands , such that they are in a fully functioning state. (fig. 2-7). (2) Forested stands are maintained in a healthy condition. (3) Standards and Guidlines within the Northwest Forest Plan are applied as they relate to management activities, in a tier 1 watershed, on matrix lands, and in riparian reserves.

Stream crossings and roads in the active flood plain do not interfere with the functions and processes of the aquatic ecosystem, and are designed to withstand a 100-year flood event.

Open road densities should be reduced in all land allocations to the levels that are prescribed in the ATM Plan.

South Fork Landscape Unit

Most of this LU is a Special Emphasis Watershed (The Dalles Municipal Watershed) (B6). The desired conditions for this area are geared toward providing high quality water into the future. To ensure this, at least 75% of the harvestable acres will be in a hydrologically recovered state (60-90% canopy closure in fire group 3, and 30-60% in fire group 2). There would not be any created openings in riparian reserves. Large woody debris, bank stability, and high quality cutthroat trout habitat are within natural conditions above Crow Creek Dam. Below Crow Creek Dam, the City of The Dalles facilities (Wickes Treatment Plant) and water quality/quanity values are protected. Forest stands are in a sustainable condition, with the lowest risk of stand replacement fire and insect outbreaks possible. A portion of this LU is designated as the Mill Creek Research Natural Area (RNA) (A3). The desired conditions for the RNA are forest, woodland and grassland structure and composition that are reflective of natural processes.

Stands meet 100% biological potential for snags. Large woody debris, shade and bank stability are protected in riparian areas. In addition road densities are at a minimum, reduced to Forest Plan Standards and Guidlines.

Mill Creek Buttes Landscape Unit

Mill Creek Buttes LU lies entirely within the LSR designation and within The Dalles Municipal Watershed (B6).

The desired conditions for this LU are as follows: forested areas consists of unfragmented, closed canopy late seral forest. Stands are multi-layered and have significant numbers of large trees. Stands meet 100% biological potential for snags. Large woody debris, shade and bank stability are protected in riparian areas. Limited access continues in this area. The unique habitats that exist here (Ponderosa pine stands, grassy openings) are maintained.

Stroud Landscape Unit

This landscape unit lies entirely within the Surveyors Ridge Late-Successional Reserve (LSR). Late Successional Reserves are a designation from the Northwest Forest Plan. The desired future conditions for this landscape unit (LU) reflect the objectives of LSRs to promote late seral conditions throughout the LU. In addition all of the LU lies inside The Dalles Municipal Watershed (B6).

The desired future conditions for this LU are as follows; Forested areas consists of unfragmented, closed canopy late - seral forest. Stands are multi-layered and have significant numbers of large trees. The stands meet the 100% biological potential for snags. Large woody debris, shade and bank stability are protected in riparian areas. Limited access continues in this area.

The DFC down woody debries (DWD) for Mill Creek Watershed are in the dry grand fir plant associations 3-13 tons of debries per acre, and at least 1 tree-length log be left per acre. In the moist grand fir plant associations 10-20 tons per acre would be available, and at least 3 tree-length logs per acre would be left. The watershed team is assuming that in all these situations trees are 20" DBH and at least 100' long.

Table IV-1 -refer to figure 4-1. This is the Table form of the DFC as seen on the previous two pages.

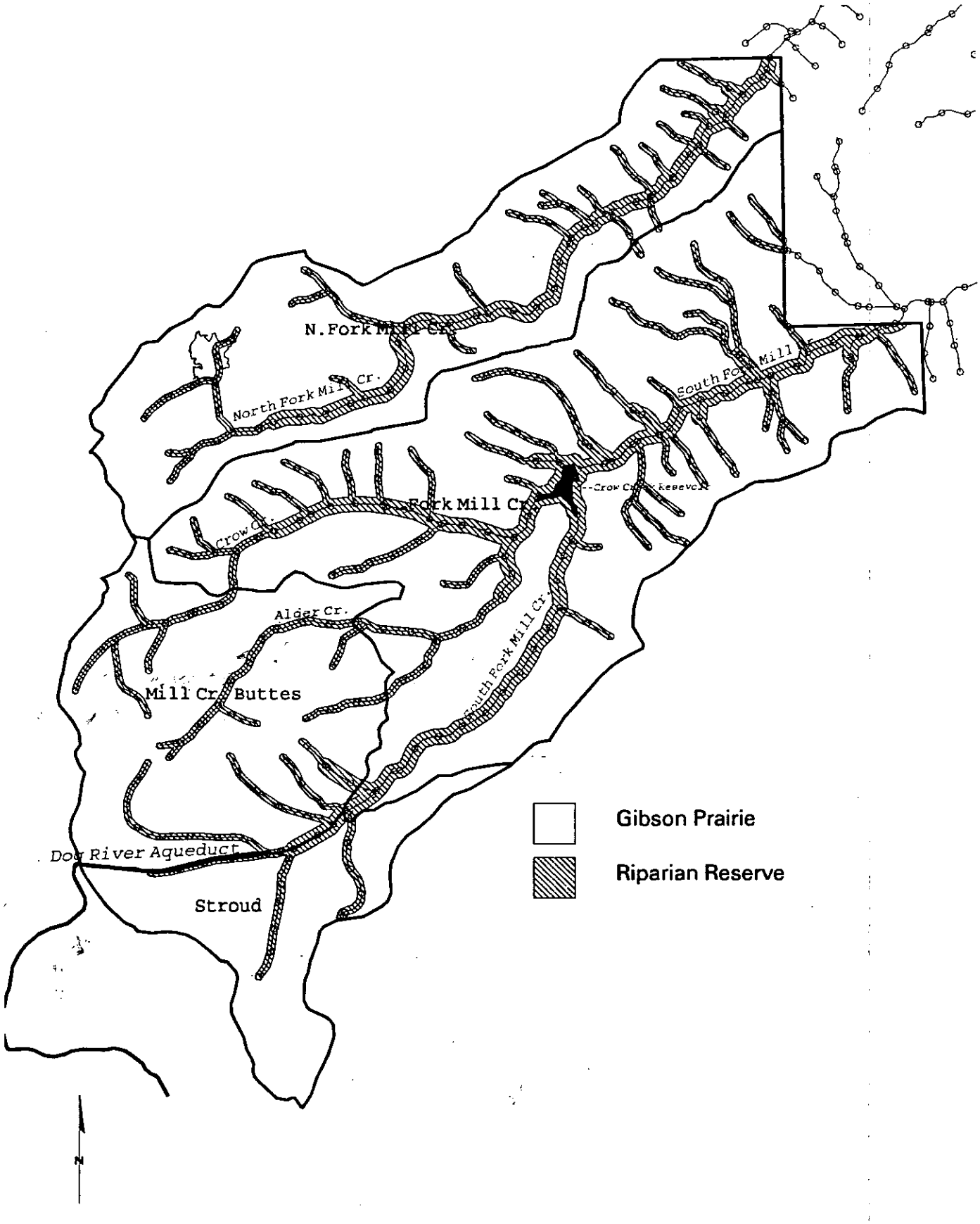
Landscape Unit	Land Allocation	Desired Future Condition
NORTH FORK	A7 - Special Old Growth	· Old growth characteristics and values are maintained. (** need to follow up on location and existing condition)
	B10 - Winter Range	· Thermal and optimal cover is maintained on as much area as is capable of producing and maintaining it in a healthy condition. · High quality forage is maintained in natural openings. · During critical winter stress period, interactions between humans and deer/elk are minimized. · Winter recreation is restricted to existing roads.
	C1 - Timber Emphasis	· Wetlands at Gibson Prairie and riparian hardwood area (see fig. 2-7) are fully functioning. · Forested stands are maintained in a healthy condition. · Refer to NW Forest Plan for standards/guidelines for matrix lands and riparian reserves.
	General	· Stream crossings and roads in the active floodplain do not interfere with the functions and processes of the aquatic ecosystem, and are designed to withstand a 100-year flood event. . Open road densities are reduced to levels prescribed in the Travel and Access Management Plan.
SOUTH FORK	B6 - Special Emphasis Watershed.	· >=75% of harvestable acres are in a hydrologically recovered state (60-90% canopy closure in FRG 3; 30-60% in FRG2) · No created openings in riparian reserves. · Large wood, bank stability and high quality cutthroat trout habitat are within natural conditions above Crow Creek Dam. · Below Crow Creek Dam, City of The Dalles facilities and water quality/quantity values are protected. · Forest stands are in a sustainable condition, with the lowest risk of stand replacement fire and insect outbreaks possible.
	A3- RNA	. Natural Range of conditions in pine/oak woodlands, pine-douglas-fir forest stands and grassy openings.
MILL CREEK BUTTES	LSR-Northwest Forest Plan.	· Forested area consists of unfragmented, closed canopy late seral forest. · Stands are multi-layered and have significant numbers of large trees. · Stands meet 100% biological potential for snags. · Large wood, shade and bank stability are protected in riparian areas. · Limited access continues. · Unique habitats (Ponderosa pine stands, grassy openings) are maintained.
STROUD	LSR-Northwest Forest Plan.	· Forested area consists of unfragmented, closed canopy late seral forest. · Stands are multi-layered and have significant numbers of large trees. · Stands meet 100% biological potential for snags. · Large wood, shade and bank stability are protected in riparian areas. · Road densities are reduced to Forest Plan Standards/Guidelines at a minimum.

The DFC down woody debries (DWD) for Mill Creek Watershed are in the dry grand fir plant associations 3-13 tons of debries per acre, and at least 1 tree-length log be left per acre. In the moist grand fir plant associations 10-20 tons per acre would be available, and at least 3 tree-length logs per acre would be left. The watershed team is assuming that in all these situations trees are 20" DBH and at least 100' long.

Chapter V

Figure 5-1

Mill Creek Watershed Riparian Reserves



Chapter V: Recommendations/Restoration

The information in this chapter are recommendations not direction. Lands not managed by the Forest Service are also covered. These recommendations are given to promote the health and any restoration needed to maintain the Mill Creek Watershed in a fully functioning condition, now and into the future. The recommendations are also geared towards moving the watershed towards the desired future conditions outlined in the previous chapter.

Riparian Reserves

For those areas designated as riparian reserves (see figure 5-1), it was determined by the watershed team that the interim riparian reserves defined by the Mt. Hood National Forest, in conjunction with the Aquatic Conservation strategy (Record of Decision, Northwest Forest Plan) would be adequate. It is recommended that when site specific analysis can be done in the areas of the reserves, that the actual widths and final boundaries for the reserves be identified at that time, and mapped in the Geographical Information System (GIS).

Table V-1-Recommendations and Restoration

Landscape Units	Recommendations	Restoration
North Fork	- Restore underburning fire in Fire Group 2 and in natural openings. - Develop a long term plan for the Aspen in he west half of the LU. - Re-evaluate the widespread use of planting ponderosa pine in the higher elevations; consider diversifying species of future plantings, so as to mimic existing forested areas. Utilize disease and insect resistant species where possible where they are sucseptible to localized insect and disease problems. - Reduce wildlife harassment, on road 1700662 change current ATM plan recommendation to something other than the current gate sys tem (i.e. Berming or entrance management . - Recommend to county that access and residences be located outside the active flood plain. - Develop a management plan for the (A7) Special Emphasis Old Growth area.	- Develop a plan to restore Gibson Prairie. - Evaluate all roads and stream crossings within the flood plain; develop a strategy to minimize damage from 100 year events. - Maintain existing pasture fences to control livestock and avoid trespass. - Develop a maintenance plan for road 1711630, which will reduce erosion and off site sedimentation. - Continue to stabilize and reforest the School marm Fire area. - Remove motorized use on trail 451, North Section Line. - Remove non-system roads as opportunities present themselves to do so.
South Fork	- Prioritize stands for fuel reduction (prescribed underburning) and reintroduction of fire. - Analyze the genetic makeup of the cutthroat trout above Crow Creek Dam, to see if they are the same or different then those found in Dog River. - Look into the level of interest of having a uni versity do research in the Research Natural Area, on the native grass ecosystems and Oak Woodlands. Management plan needed. - Recommend to county that residences be lo cated out of the floodplain. - Trade land ownership of the Crow Creek Dam site from Forest Service to the City of The Dalles.	- Review and check adequacy of drainage systems (i.e. Culverts and stream crossings) and ensure they are adequately sized to handle peak flows. - If the opportunity presents itself large woody debris may be needed in the streams that historically were cleaned out. - The open road densities are reduced to ( ) the recommended density in the ATM Plan. - Maintain range fences to minimize cattle trespass. - Remove non-system roads as opportunitties present themselves to do so.

Landscape Units	Recommendations	Restoration
Stroud	- Silvicutural prescriptions for harvested areas should promote canopy layering and big trees. Favor reforesting tree species that are insect and root rot resistant. (i.e. White Pine, Western Larch, Noble fir, Englemann Spruce, Western Hemlock.) - Review and checkout the significance of huckleberry patch. (Located during the scopi ng process of this analysis.) Do we maintain it in its current state? - Along the northwest boundary along road 17, thin and prune trees to reduce fire risk. - Review stand conditions every 10 years, due to historically above normal mortality from insect and disease problems. - Avoid creating openings large enough to make stands susceptible to windthrow. - Spotted owl calling needs to be done prior to any treatments. Due to entire LU in LSR.	- Look for large woody debris recruitment for streams and clearcuts. - Look for opportunities for road obliterations. - Remove non-system roads as opportunities present themselves to do so.
Mill Creek Buttes	- Spotted owl calling need to be done prior to any treatments. Due to entire LU in LSR. - Underburning should not be a tool to main tain stand structure, but could be used to reduce the fuel load in the fire group 2 stands. - Thin in younger high density stands. - Reduce the risk of fire along road 17. (i.e. con struct fuel breaks, thin out the numbers of trees along the road.) - Utilize logging systems that minimize com- paction. - Assess the need for thinning from below in fire group 3. If need does exist, then co- ordinate with the Regional Ecosystem Office and review the Surveyors Ridge Late Suc- cessional Reserve Analysis document and ex- emption letters, prior to implementation. - Review harvested units to ensure that an in sect and disease resistant mix of species is coming in for this LU, and to the extent pos- sible mimics the existing forest.	- Have a periodic review of stand conditions every 10 years. - Look at replacing large woody debris in exist ing clearcut units when the opportunity presents itself. (i.e. Crow Creek unit 10) - Remove non-system roads as opportunities present themselves to do so.

Landscape Units	Recommendations	Restoration
Rural	- Recommend to county that access to resi dences be located outside the active flood plain. - Encourage pruning and other fire risk reduction practices near residences. - Encourage maintenance of defensible green spaces, that reduce the risk of fire around residences. - Encourage the storage of hazardous materials outside the active floodplain.	- Seek opportunities that would restore the riparian vegetation and function. - Encourage that bridges and culverts are sized to handle peak flows. - Assess the feasibility of protecting the Mill Creek Pipeline/infrastructure (roads, ect) by relocating outside the active floodplain.
The Dalles	- Relocate sewer line outside the active flood plain. - Encourage the storage of hazardous materials outside the active floodplain. - Encourage pruning and other fire risk reduction practices near residences. - Encourage maintenance of defensible green spaces, that reduce the risk of fire around residences.	- Assess feasibility of diverting Mill Creek from tunnel and restoring wetlands. - Encourage the planting of native species along Mill Creek and tributaries. - Encourage that bridges and culverts are ad equately sized to handle peak flows.

The following recommendations are for downed woody debries and can be applied across the watershed.

Table V-2: Down Woody Debries Recommendations

Source	Amount	Specifications	Remarks
Mill Creek Watershed Analysis	Dry Grand Fir 3-13 tons per acre. Moist Grand Fir 10-20 tons per acre.	Dry Grand Fir; At least 1 tree-length log per acre. Moist Grand Fir; At least 3 tree-length logs per acre.	We are assuming in the dry and moist grand fir areas trees are 20" DBH and at least 100' long.

Other Recommendations

Part of the analysis the Watershed team was to do included Probable Sale Quantities (PSQ) for the portion of the watershed that is managed by Forest Service on the Barlow, and Hood River Ranger Districts. Any volume removed would consider the following:

(1) No volume is planned out of the riparian reserves. However, if the stands in the riparian reserves exhibit poor health, they will be evaluated for possible treatment.

(2) The volume figures displayed are from the upland areas.

(3) Silvicultural prescriptions will try to achieve the maximum canopy closure be left on site, while reducing the risks of insect and disease outbreaks and spread, and fire (stand replacing events). In addition the prescription should be moving the stands towards the Desired Future Conditions outlined in chapter IV.

4) Volume removed from Surveyors Ridge LSR would occur under the guidelines and exemption letters for permitted silvicultural treatments that were developed in the Surveyors Ridge Late-Successional Assessment (1997) process.

In the first decade the following LU's could be entered; South Fork Mill Creek, North Fork Mill Creek, and Stroud. In the second decade the following LU's could be entered Mill Creek Buttes, Stroud, and North Fork Mill Creek again. Table V-2

Table V-3 - Probable Sale Quantity by Landscape Unit

Landscape Unit	Available Acres[1]	Treatable Acres[2]	PSQ MMBF[3]
South Fork - 1st Decade	2863	1633	13
Stroud - 1st Decade	1408	357	25
Mill Creek Buttes - 2nd Decade	2276	1709	7.5
Stroud - 2nd Decade	2105	1241	8.7
North Fork - 1st Decade	2079	1272	6
North Fork - 2nd Decade	1579	772	3

1/ Available acres are total acres of National Forest System lands within the landscape unit minus those acres of previous harvest activities.
2/ Treatable acres are estimated acres where potential harvest opportunities on National Forest System Lands could occur within the limits of the standards and guidelines of the Mt. Hood NF Land and Resource Management Plan.
3/ Million board feet.

R6 Sensitive Plants, Restoration - Recommendation.

Handpull weeds in areas of highest concern. Decompact soils in habitat, (ripping roads increased the population of sickle-pod rockcress in an adjacent watershed). Omit habitat areas from open range grazing allotments. Conduct an intensive public awareness campaign by providing educational material at the trailhead that discusses the above problems, potential solutions, and pertinent restoration projects in the area.

Details for restoration will be developed on a site-specific basis and should be coordinated at an interdisciplinary level. Input from a range specialist.

Road recommendations.

The alterations the watershed team would like to recommend, differing from the ATM plan, as mentioned on page Ch-III-Q4-1 are based on site visits to those roads recommended by the ATM Plan to be obliterated, and information the team received from folks out on the ground. All the roads we visited, with the exception of one (1700720), are in the City of The Dalles Municipal Watershed. The area already has restricted access, and public access into these areas is limited and monitored. Upon review, and finding no visible resource damage, and identification of the possible need for future access into these areas, the Watershed Team is recommending that none of the scheduled obliterations of these roads take place. Road 1721011 has already been bermed and is revegetating. Road 1700720 will be dealt with in the NEPA process for the North Fork Planning Area, as to its future. It is currently gated, with the gate closed and locked. Roads 1721120, 1721130, and 1721140 should be signed as closed, to encourage further limited travel on these roads. Road 1700661 is recommended to be bermed by the watershed team an as such in the ATM Plan. However we do recognize that this road does present an opportunitty for OHV travel. The North Fork Mill Creek planning team will be looking further into the possible OHV use through the NEPA process. The roads in question do not pose any emanate resource problems and do appear will be needed in the next 5 to 10 years. Building new roads or ripping of the road beds at this time could cause resource problems now and in the future. See Table V-4 for what the watershed team is recommending.

Overall road densities should be reduced to the levels recommended in the Mt. Hood National Forest Land and Resource Management Plan, by land allocation.

Table V-4 Mill Creek Watershed recommendations.

Road No.	Surface	Existing Length Open	Existing Length Closed	Future Length Open	Future Length Closed	Closure Device
17	Paved	5.85		5.85		
1700013	Agg	0.75			0.75	Berm
1700120	Agg		0.90		0.90	Gate TDWS
1700130	Agg		1.25		1.25	Gate TDWS
1700140	Nat		1.00		1.00	Gate TDWS Radio
1700150	Agg		1.10		1.10	Gate TDWS
1700151	Agg		0.70		0.70	Gate 150 Rd.
1700160	Agg		0.75		0.75	Gate TDWS
1700161	Agg		1.00		1.00	Gate TDWS
1700170	Nat		0.40		0.40	Gate TDWS
1700660	Agg	2.30		2.30		
1700661	Nat	1.10			1.10	Berm
1700662	Agg	3.10			3.10	Gate/Seasonal
1700663	Agg	0.30			0.30	Berm
1700664	Agg	0.20			0.20	Bermed@ 663jct.
1700665	Agg	0.10			0.10	Berm
1700720	Agg	0.40			0.40	Gate
1700780	Nat	0.10		0.10		Gate-for cattle
1711620	Agg/Nat	1.57		1.57		
1711621	Agg	1.60			1.60	Close 621-end
1711623	Agg	0.20			0.20	
1711630	Nat	2.13		2.13		
1720011	Nat		1.90		1.90	Bermed both ends
1720120	Agg		0.60		0.60	Gate TDWS
1720121	Agg		0.60		0.60	Gate 120 Rd
1720123	Agg		0.70		0.70	Gate 120 Rd
1720125	Agg		0.10		0.10	Gate 120 Rd
1720130	Agg		0.90		0.90	Gate TDWS
1720140	Agg		0.90		0.90	Gate TDWS
1720170	Agg		1.70		1.70	Gate TDWS
1720190	Agg/Nat		2.90		2.90	Gate TDWS
1720191	Nat		1.50		1.50	Gate 190 Rd
1720192	Nat		1.50		1.50	Gate 190 Rd
1720193	Nat	2.20		2.20		
1720194	Nat		1.00		1.00	Gate 190 TDWS
1720195	Nat		0.25		0.25	Gate 190 TDWS
1720196	Agg		2.00		2.00	Gate 190 TDWS
1720197	Agg		0.20		0.20	Gate 190 TDWS
1721	Pave/Agg/Nat		5.90		5.90	Gate TDWS
1721011	Nat		1.00		1.00	Gate/bermed
1721012	Agg		2.80		2.80	Gate 1721TDWS
1721013	Agg		0.70		0.70	Gate 1721TDWS
1721014	Agg		0.80		0.80	Gate 1721TDWS
1721120	Agg		1.20		1.20	Gate 1721TDWS
1721121	Agg		0.35		0.35	Gate/Sign Closed
1721130	Nat		0.25		0.25	Gate/Sign Closed
1721140	Agg		0.35		0.35	Gate/Sign Closed
Totals:	59.10 total miles	21.90	37.20	14.15	44.95	

Chapter VI

Chapter VI: Monitoring Plan

The information contained in this chapter is based on what the analysis of this watershed has shown to be needing monitoring and periodic review, either to prevent widespread resource damage or follow-up on areas we lack current data on.

Monitoring List: Monitor and Inventory for;

- Monitor and manage connectivity routes, to ensure the routes are functioning for mature habitat species over time (i.e. 50-11-40, Riparian Reserves)
- Thermal and optimal cover is maintained on as much area as is capable of producing and maintaining it in a healthy condition, in winter range areas.
- High quality forage is maintained in natural openings and in the higher elevations, within winter and summer ranges, for deer and elk.
- During critical winter stress periods, interactions between humans (i.e. restricting recreation to existing roads.) and deer/elk are minimized, in winter range areas.
- The Dalles Watershed and Research Natural Area (RNA) for tresspass livestock.
- Gibson Prairie for tree encroachment, also restoration of native plants and hydrology.
- Aspen Grove at head of North Fork Mill Creek for long term sustainability and enhancement opportunities.
- Old growth characteristics and values are maintained in the Special Emphasis Old-Growth Area (A7).
- Unique habitats (Ponderosa pine stands, grassy openings) are maintained, within the Surveyors Ridge LSR.
- Protection Buffer species (C-3 Plant and Mollusk species) within the National Forest portion of the watershed.
- Anadromous fish in the North Fork of Mill Creek within the forest boundary.
- Cope Salamanders (R6, Sensitive Species) in the South Fork of Mill, North Fork of Mill, and in Alder creeks.
- Forested stands maintaining a sustainable, healthy, and good structural condition, with the lowest risk of stand replacement fire and insect outbreaks possible.
- Forested areas consists of unfragmented, multi-layered, closed canopy, late seral forest with a significant number of large trees, within the Surveyors Ridge LSR.
- Stands meet 100% biological potential for snags, within the Surveyors Ridge LSR.
- Down log and snag retention, during post harvest, and post fuels treatments. In addition, where firewood gathering is done, post monitoring within the activitiy area should also be done.
- >=75% of harvestable acres are in a hydrologically recovered state (60-90% canopy closure in FRG 3; 30-60% in FRG2), in the Special Emphasis Watershed Area.
- Large wood, bank stability and high quality cutthroat trout habitat are within natural conditions above Crow Creek Dam, within the Special Emphasis Watershed, Surveyors Ridge LSR Areas.
- *Riparian conditions and Summer stream flows, in the North and South Forks of Mill Creek.*
- The Dalles facilities and water quality/quantity values are protected, within the Special Emphasis Watershed Area.

- Potential slide areas within The Dalles Watershed for stability.
- Stream crossings and roads in the active floodplain do not interfere with the functions and processes of the aquatic ecosystem, and are designed to withstand a 100-year flood event, in general.
- Limited access continues, within the Mill Creek Buttes portion of the Surveyors Ridge LSR.
- Road closures outside The Dalles Watershed for their effectiveness.
- Open road densities are reduced to levels prescribed in the standards and guidlines within Mt. Hood Forest PLan, Automated Transportation Management Plan (ATM), and Northwest Forest Plan.

Chapter VII

Chapter VII: Data Gaps

The following information represents the areas where the Watershed Team felt information was lacking or is needed.

Table VII-1

Landscape Unit	Data Informational Gap
North Fork	- Stand exams do not exist for all stands. - Lack of knowledge for perpetuating Aspen. (There is an extent of Aspen in this LU) - Limited information, need more information about the presence or absence and distribution of anadromous fish in the North Fork of Mill Creek within the forest boundary. - The distribution of amphibian species. - Restoration techniques for native bunchgrasses.
South Fork	- Lack of knowledge on how to restore native bunchgrass that have been displaced by non-native grasses. - Limited information about whether or not the cutthroat trout above Crow Creek Dam are a unique strain or part of the Dog River stock. Those cutthroat found in Crow Creek may also be from Dog River, so research is needed to make this determination. - Lack of surveys about the distribution of cutthroat trout upstream from the Dam. - The distribution of amphibian species.
Stroud	- Survey whole South Fork Mill Creek for cuthtroat trout. - Surveys for spotted owls prior to any treatments on the ground. - Determination of whether or not the cutthroat trout are a unique strain or are the same as those found in Dog River. - The distribution of amphibian species.
Mill Creek Buttes	- Surveys for spotted owls prior to any treatments on the ground. - Survey for cutthroat trout distribution in the streams. - The distribution of amphibian species.
Rural	- Riparian condition surveys - Stream channel surveys. - The distribution of amphibian species.
The Dalles	- Determine what the impacts are on fish passage in and out of Mill Creek, given the fish currently must pass through a tunnel, which runs from 2nd street in The Dalles to the Columbia River. This is a distance of 950 ft. - The distribution of amphibian species.

Overall Gaps:

- Lack of survey/distribution info for C-3 Plant, mosses, lichens, fungi, and Mollosk species within the National Forest portion of the entire watershed.
- Limited surveys about the presence of Cope Salamanders (R6, Sensitive Species) in the South Fork of Mill Creek, North Fork of Mill Creek, the portion of South Fork Mill Creek that runs through the Stroud LU, and Alder creek. More information is needed about the numbers present and where they are located/distributed within the watershed.
- Lack of information about the Fire histrory of the area prior to the turn of the century.

Chapter VIII

Proposed Management of Identified Fire Risks

Prescribed Natural Fire. Standards and Guidelines in the Northwest Forest Plan permit the use of prescribed natural fire (PNF) to meet overall fire risk and fuel reductions within a watershed. We believe the North and South Forks of Mill Creek would be good candidates for PNF. We recommend that the prescription limit the PNF candidate fires to those starts which will produce only low to moderate intensity fires, at least for the next 10 years.

The prescription parameters should consider:

1. Drought Conditions,
2. Large Fuel dryness,
3. Current and expected wind speed and direction,
4. Proximity to existing late successional and old Growth stands,
5. Probability of burning into and reducing late successional and old growth,
6. Threats to water quality and infrastructure in The Dalles City Watershed, and
7. Proximity to Surveyors Ridge LSR and the Forest Boundary.

Allowing low and moderate intensity fires to burn will help reduce some fuel buildups and create stand diversity by altering species compositions and creating snags. Restoring fire will also help maintain the disturbance dependent old growth structures (Cathedral and Open Parklike).

Management Ignited Prescribed Fire. Standards and Guidelines in the Northwest Forest Plan also permit the use of management ignited prescribed fire to meet overall fire risk and fuel reductions within a watershed. In addition, consideration must weigh possible impacts that prescribed fire might have on water quality within The Dalles Watershed portion of the Mill Creek Watershed. Due the sensitivity of The Dalles Watershed and the orientation of Mill Creek (SW to NE), given the prevailing winds and proximity to Surveyors Ridge, prescribe natural fire is not advisable at this time. Instead restoring the ecosystem functions of fire may depend on planned ignitions. We may also want to use management ignited prescribed fire first before allowing PNF in Mill Creek Watershed in order to reduce the risk of stand-replacing fire. Some mechanical vegetation manipulation to reduce the risk of high intensity fires and escaped fires may be appropriate. Such manipulations would reduce the presence of ladder fuels and of fire sensitive species.

Prescribed burns should occur on about the same interval as estimated for pre-1855 conditions. More detailed fire history studies using fire scarred trees would help better establish an appropriate return interval, assuming a significant number of living trees or stumps of known date-of-origin remain in or adjacent to the watershed. Prescribed burning of natural fuels generally is not appropriate in Fire Group Four. Some exceptions may exist in ponderosa pine plantations; burning could open the plantation and create a seedbed suitable for other species. The grand *fir/golden chinkapin plant association is one of the drier associations in group four and may be able to tolerate some* underburning. Similarly, underburning should be used cautiously in the grand fir/twinflower plant association of fire group three. This association lies on the wet end of Group Three and could support Late Seral Multistory stands in some locations.

Initially, we expect such management ignited prescribed fires to be conducted in spring in order to better control fire effects. Of particular concern is the buildup of needles and bark flakes around large diameter ponderosa pine. Raking these accumulations well away from the boles is an acceptable alternative to spring burning provided such raking occurs at least one year before the planned burn. Studies in other areas have found that many fine roots have migrated into this pedestal of needles and bark flakes in order for the tree to capture scarce moisture. Raking reduces

expected fire intensity and severity around the bole, but damages and destroys many of the fine roots. Raking at least one year in advance of the burn should allow the tree to replace the lost and damaged roots. These roots should re-grow deep enough in the soil profile to adequately protect them from low severity fire.

Site specific burn plans will identify objectives and monitoring needs for each burn, as required by Forest Service Manual direction and the FEIS for managing competing and unwanted vegetation. The Barlow Ranger District integrated resource analysis for burning natural fuels also contains a potentially useful monitoring plan.

The lack of access means using management ignited prescribed burn along Surveyors Ridge and parts of the North and South Forks LUs will be difficult and expensive. Use of this tools may be limited and restricted to less ecologically desirable burn times. If management ignited prescribed fire is identified as not cost effective or too unsafe, then burning should concentrate on the adjacent forests. The greatest need for restoring fire as a primary ecosystem function is in Fire Group Two and Three.

Fire Suppression Guidelines

Appropriate Suppression Response. Three suppression responses to wildfires are allowed under manual direction--confine, contain, and control. The Mt. Hood National Forest uses a centralized dispatch system on single starts and a district dispatch system on multiple starts. All fires handled by Mt. Hood Dispatch start with a control strategy. Since district dispatch is not employed until multiple starts occur, burning conditions are such that only a control strategy is used. Confine and contain strategies are almost never used.

The wildfire management goal within the Late Successional Reserves is to keep all stand-replacing events as small as possible. However, few wildfires have the potential to become stand-replacing events. Wildfires with the lowest probability of this type of burning are those that occur outside the main fire season (before June 15th and after October 15th) in most years. In wet years such as 1995, even fires starting within the main fire season have a low probability of transitioning into a stand-replacing event.

Until a PNF Plan is prepared and approved, all fire starts are declared wildfires. Even after approval of a PNF plan, regional policy is that all human-caused starts are declared wildfires. A given start that is a good candidate for a prescribed natural fire under the physical and ecological guidelines of the PNF plan may still be declared wildfires due to social considerations or the regional or national fire load at the time of the start.

We recommend greater use of confine and contain strategies within the Mill Creek Watershed on declared wildfires to improve the cost effectiveness of wildfire suppression and to use the available fire fighting forces more efficiently. We did not have time to fully develop guidelines for use of confine and contain strategies. Appropriate indicators for use of either strategy would be time of year, current levels in selected fire indices, current trend in indices, fire location, and fire potential. A matrix could be developed that uses time of the year and one or more fire danger index, such as Energy Release Component (ERC). Table VIII-1 displays an example of such a matrix. A copy of the running trend of selected indices that includes the historical average, a dry year of years, and a wet year of years would assist in the decision-making process for use of alternative suppression strategies. Separate matrices would probably be needed for Surveyors Ridge, North Fork Mill Creek, South Fork Mill Creek, and the rest of Mill Creek watershed.

Table VIII-1. Example of a decision matrix for the appropriate suppression response.

Fuel Model G-- South Fork Mill Creek

Time of Year	0-30th Percentile ERC	30-50th Percentile ERC	+50th Percentile ERC
October 15 - June 15	Confine	Contain	Contain or Control
June 15 - July 15	Confine or Contain	Contain or Control	Control
July 15- September 15	Confine or Contain	Control	Control
Sept. 15 - October 15	Confine	Contain or Control	Control

Once the 90th percentile of the selected fire danger index is reached, burning conditions are generally extreme and a control strategy is the only acceptable option. Experience has also shown that rapid initial attack is critical to successful initial attack under extreme burning condition. Any delays are much more likely to result in an escaped fire and a stand-replacing event. Energy Release Component is a good indicator of seasonal and long-term drought since this value is influenced by 1000 hour fuel moisture. Throughout Mill Creek Watershed, NFDRS fuel models C and G are currently the most suitable for evaluating fire danger and escaped fire risk.

Minimum Impact Fire Suppression. Safety of fire fighters and forest users is the highest priority in all suppression efforts. All fire suppression activities must follow guidelines developed in the Fireline Handbook and listed by the hazard abatement plan developed after the South Canyon Fire Deaths. Late Successional Reserve (LSR) standards and guidelines require use of the minimum impact suppression tactics ("light hand" tactics) designed to minimize the size of all wildfires while producing the least possible impact on late successional and old-growth habitat. Elements of particular concern are late-successional and old-growth stands, snags, downed logs, and duff.

Moody and Mohr (1988) developed a guide for minimum impact suppression tactics, which we recommend for use on both wildfire suppression and for mop-up of prescribed burns within the LSR and Riparian Reserve boundaries. Minimum impact tactics include such practices as:

- Allowing fires to burn to natural barriers.
- Minimizing constructed fireline and fireline width; use of fireline explosive (FLE), cold-trailing, and wet line to lesson impacts from constructed line.
- Minimizing bucking and felling of trees and snags in line construction.
- Removing only those limbs with potential to spread the fire beyond the fireline.
- Allowing trees and snags to burn out instead of felling them, provided they do not pose a significant safety risk to firefighters or pose a significant risk of spotting outside the fireline.
- Limiting use of bulldozers to slopes of less than 25%
- Minimizing spading, or "potato patching" during mop-up; as much as possible using water or foam and stirring or allowing fuels to burn out naturally.
- Minimizing bucking during mop-up; instead attempting to roll logs to extinguish the fire.
- Extinguishing smoldering logs as soon as possible.
- Locating portable pumps to minimize the risk of fuels spills entering streams, ponds, or other areas containing water; keeping hazardous materials spill kits in close proximity to all portable pumps.

Post fire rehabilitation needs should be identified quickly and rehabilitation carried out both quickly and at ecologically appropriate times. For, example, seeding should not occur at times when germination and subsequent survival are expected to be very low. Erosion control seeding should rely on native species or sterile non-native species as much as possible.

Logistics. No suitable locations for incident base camps or camps for 100 people or more exist within Mill Creek Watershed. Suitable locations for smaller camps and spike camps may exist. Table VIII-2 list some potential camp locations. No wet meadows such as Brooks Meadows, Gibson Prairie, or The Dalles Watershed should be used as campsites. Dry meadows such as High Prairie, may be used as short term camps. When laying out camps, minimize the

number of trails needed to reach cooking, eating, sleeping, latrine, water supply, and other locations. Do not allow crews to clear vegetation or dig trenches in sleeping areas. Use sawdust or other material on trails to minimize potential erosion. Use commercial toilets in camps in roaded areas; do not depend on campground and day use area toilets. In remote areas, sling in portable toilets or materials to construct portable latrine areas whenever possible. Avoid constructing primitive latrines. Track all camp impacts and develop and update camp rehabilitation plans.

Use of roads 4400-011, 1700-014, and 1700-130 to transport heavy equipment should be avoided if possible and minimized if essential. Dog River Aqueduct, a wooden pipeline constructed in the 1920s, lies under or along these roads. Heavy equipment could severely damage this now-fragile structure. Limit the use of native surface roads to transport large numbers of crews and equipment. Off road vehicle travel should be limited only to the minimum essential to meet fire suppression objectives or to protect firefighter safety.

Table VIII-2. Potential fire camp locations for wildfire suppression in Surveyor's Ridge LSR.

Type of Camp	Location	Comments
Incident Base Camp	Hood River County Fairgrounds, Odell	Helibase also
	Wahtonka High School, The Dalles	Helibase also
	The Dalles Rodeo Grounds, The Dalles	Helibase also, except during Rodeo period July.
Spike Camps/Day Sleeping[1]	Gibson Prairie Horse Camp	Need to survey for sensitive plants and archeological sites before using.
	Long Prairie	Campsite used by permittees to gather cattle allotment; need to survey for sensitive plants and acheological sites before using.
	High Prairie	Need to survey for sensitive plants and acheological sites before using.
	Upper Eightmile Campground	
	Knebal Springs Campground	Room for small kitchen and shower trailers.
	Camp Friend	Need survey for sensitive plants and archeological sites before using.
	Camp Baldwin Boy Scout Camp	Limited Availability
	Little John Sno-Park	Room for small kitchen and shower trailers
Helispots	Rock Pits	Light helicopters only
	Grassy balds on Surveyor's Ridge	

Air Operations. No natural openings with adequate access are available for use as a helibase within the watershed. However access by air is available at the The Dalles airport in Dallesport, Washington. Some rock pits are suitable for use as helispots, but none can handle anything larger than a light helicopter. Helicopters should not use wet meadows. Helispot construction should be minimized. If a spot is to be used only for cargo drops, use slings and longline in lieu of constructed helispots. No helibases should be constructed. Locate helicopter fueling areas outside Riparian

[1]Unless otherwise noted, camps are intended to serve up to six 20-person crews with parking for vehicles and outhouses; no kitchens, showers, or other amenities and services.

Reserves whenever possible. If a helicopter fueling area is located in a Riparian Reserve, a hazardous materials spill kit large enough to handle the available fuel must be located no farther than 5 minutes away from the site.

As stated in the Northwest Forest Plan and the Mt. Hood Forest Plan, retardant drops should be directed to minimize entry of chemicals into streams, lakes, water courses, or other waterbodies. Uncolored or fugitive chemical suppressants and other water additives should be considered on Surveyors Ridge. As soon as possible, switch to using helitankers and buckets near waterbodies. Helitankers and helicopters with buckets can make more precise drops than air tankers, lowering the probability of accidental drops into streams and wet areas.

Rehabilitation. Rehabilitation plans must be designed to restore or move the area towards the late successional or old growth conditions in the LSR, prevent or stop sediment from reaching Riparian Reserves, and restore camp sites and similar areas to pre-fire condition. Wildfire suppression and the logistical support to the effort will cause some significant damage regardless of how careful and conscientious incident managers and firefighters are. Some rehabilitation work may be needed on fires 1-5 acres in size that occur in sensitive areas.
Rehabilitation guidelines include:

- Pick up and remove all flagging, garbage, litter, and equipment. Reduce the need for litter and garbage pickup by recycling as much material as possible.

- Discourage the conversion of constructed firelines to recreational trails, by covering the line with brush, limbs, and both sound and rotten logs. The preferred source of these materials is the material removed to construct the line.

- Fill in cup trenches and dug out areas and obliterate berms created during the suppression effort.

- Construct waterbars as needed to reduce erosion on steeper slopes. A soil scientist or hydrologist will provide guidance on the spacing needed.

- Consider subsoiling compacted areas in incident base camps, spike camps, and other high use areas. Scattered rocks and logs and/or transplant small trees and shrubs into the rehabilitated area.

- Erosion control seeding and other rehabilitation work involving planting should use native species or sterile non-native species whenever possible.

- Flush cut and cover with soil all stumps in high use or visually sensitive areas, such as along road 17; campgrounds; or heavily used dispersed campsites.

- Reshape any constructed helispots in visually sensitive areas or designated viewshed to more closely resemble a natural opening. This rehabilitation effort will likely require falling more trees and potentially the loss of some late successional or old growth trees or habitat.

- Care should be taken to lessen and minimize sediments and debris from entering any of the waters flowing within The Dalles Watershed. Since the waters here are for domestic use, then any rehabilitation that needs to be done following a fire should be done here first.

The incident resource advisor may require additional rehabilitation within the LSR, Riparian Reserves, and The Dalles Watershed to meet their objectives. A resource advisor will decide soon after a wildfire is reported whether rehabilitation might be needed. Rehabilitation planning and implementation should begin as soon as possible after firefighting efforts begin and must begin before the fire is declared contained.

Post Fire Monitoring and Evaluation. Post fire monitoring and evaluation will serve to identify areas of this plan or of the suppression effort that need improvement, formulate different strategies and tactics to add to the plan, and

assist in adaptive management. Initial evaluation should occur before the firefighting effort ends on all extended attack and project fires. This evaluation should discuss the strategy and tactics used and success or failure of minimum impact tactics in meeting LSR, Riparian Reserve, and The Dalles Watershed objectives, standards, and guidelines. It should also discuss whether firefighter safety was compromised and what changes might be made to better protect firefighters and still meet LSR, Riparian Reserve, and The Dalles Watershed objectives. Lastly, the evaluation should rate the incident resource advisor and the Escaped Fire Situation Analysis in providing clear direction to the incident management package and with the LSR Assessment and Mill Watershed Analysis.

Within one year of any fire exceeding 5 acres, an interdisciplinary team should revisit the burn area to ascertain the success or failure of rehabilitation in meeting LSR, Riparian Reserve, and The Dalles Watershed objectives, standards, and guidelines. This should be comprised of resource specialist and/or folks representing the The Dalles Watershed, with expertise in areas of concern on a given fire and a representative of the fire management organization. A team need not be very large if the concerns or items under evaluation are considered minor or small scale. A copy of the evaluation should be filed with the incident management organization, line officer, LSR Assessment, and the Mill Creek Watershed Analysis.

Glossary

Glossary

Accelerated Erosion and Sediment Yield - The increase in erosion and sediment yield above natural levels as caused by human activities.

Acute - A disturbance regime where several decades typically pass between events on the same piece of ground.

Aggradation - The up-building performed by a stream in order to establish or maintain uniformity of grade or slope.

Alluvial - Deposited by a stream or running water.

Aquatic Ecosystem - A water based ecosystem (see ecosystem). An interacting system of water with aquatic organisms (plants and animals).

Anadromous - Fish that swim from the ocean up streams to spawn.

Beneficial Values - Beneficial values as defined for the Mill Creek Watershed are those primary or unique values and human uses toward which management expends resources. In this context, **primary** refers to those values which have a higher importance relative to other values, and **unique** refers to rareness of occurrence in the Hood subbasin.

Biodiversity - see Biological Diversity.

Biological Diversity - The variety of life and its processes, including the variety of genes, species, ecosystems, and the ecological processes that connect everything in ecosystems.

Biomass - The total mass of living organisms in a biological system. The above-ground portions of shrubs and trees, excluding material that meets commercial sawlog specifications.

Biota - All the species of plants and animals occurring within an area or region.

Candidate Species (C2) - A species of plant or animal being considered for listing as a federally endangered species.

Catastrophic Event - A large scale, high-intensity natural disturbance that occurs infrequently.

Channel (watercourse) - An open outlet either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided.

Chronic - A disturbance regime where a few decades or years typically pass between events on the same piece of ground or feature.

Climax Community - The final or stable biotic community in a successional series which is self-perpetuating and in dynamic equilibrium with the physical habitat.

Cohort - A group of trees developing after a single major or minor disturbance with a range in ages of individuals; an age class of trees.

Community - An aggregation of living organisms having mutual relationships among themselves and to their environment.

Connectivity - see Landscape Connectivity.

Corridor - Route that permits the movement of species from one Ecoregion, Province, landscape or ecosystem to another, or the landscape elements that connect similar patches through a dissimilar matrix or aggregation of patches.

Cumulative Effects Analysis - An analysis of the effects on the environment which results from the incremental impact of a proposed action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person undertakes such other actions.

Cumulative Watershed Impacts - Impacts occurring away from the site of primary development which are transmitted through the fluvial system. The impacts occur through both increases in peak stream flows and through increased sediment levels. The effects generally are concentrated within stream channels which can lead to bank undercutting, channel aggradation, degradation, and inner gorge mass wasting.

Debris Torrents - A mass wasting process which results from a debris slide or avalanche entering and flowing down a steep gradient stream channel. As the mass entrains more water, it scours and transports large quantities of organic material and sediment. This material is generally deposited as the channel gradient decreased or a significant obstruction is met. Torrents generally contribute a secondary mass wasting along the margins of the scoured channel.

Debris Slide/Avalanche - A mass wasting process characterized by a relatively shallow failure plane, which generally corresponds to the soil/bedrock interface. The distinction between an avalanche and a slide is that a slide moves slower, and retains more of a coherent slide mass. An avalanche generally fails rapidly, with the slide mass disaggregating, and sometimes flowing, depending on the water content.

Desired Condition - Objectives for physical and biological conditions within the watershed. They may be expressed in terms of current conditions, ecosystem potential, or social expectations. They describe the conditions that are to be achieved and are phrased in the present tense.

Desired Future Condition - see Desired Condition.

Disturbance - A discrete event, either natural or human induced, that causes a change in the existing condition of an ecological system.

Disturbance Process - Events which cause changes in landscape features which are readily visible and measurable. The events usually occur over a brief period of time and usually can be viewed. We do not consider drought, dry-wet cycles, and other climatic changes as disturbance processes under this definition; these items are considered separately. In this analysis, only events which operate at the landscape or watershed level are considered. Examples of events are fires, epidemic insect outbreaks, beaver ponding, and erosion.

Diversity - The distribution and abundance of plant and animal species and communities in an area.

Drainage Area - The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide.

Duration - How long a disturbance event typically lasts, not how long the effects associated with an event typically last.

Early Seral - Created openings of small diameter trees (generally less than 5 inches DBH) where the canopy has not closed (canopy closure less than 50%). A remnant overstory may be present but the canopy closure of that overstory does not exceed 25% in the Eastside Zone, 30% in the Transition Zone and Crest Zone. Includes regeneration harvests and stand-replacing events. STEM INITIATION

Ecological Classification - A multifactor approach to categorizing and delineating, at different levels of resolution, areas of land and water having similar characteristic combinations of the physical environment (such as climate, geomorphic processes, geology, soil, and hydrologic function), biological communities (such as plants, animals, microorganisms, and potential natural communities), and the human dimension (such as social, economic, cultural, and infrastructure).

Ecological Process - see Ecosystem Functions

Ecology - The science of the interrelationships between organisms and their environments.

Ecoregion - A continuous geographic area in which the environmental complex, produced by climate, topography, and soil, is sufficiently uniform to develop characteristics of potential major vegetation communities.

Ecosystem - The complex of a community of organisms and its environment functioning as an ecological unit in nature.

Ecosystem Functions - The major processes of ecosystems that regulate or influence the structure, composition and pattern. These include nutrient cycles, energy flows, trophic levels (food chains), diversity patterns in time/space development and evolution, cybernetics (control), hydrologic cycles and weathering processes.

Ecosystem Processes - see Ecosystem Functions

Ecosystem Management - Using an ecological approach to achieve the multiple-use management of national forests and grasslands by blending the needs of people and environmental values in such a way that national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems. The careful and skillful use of ecological, economic, social, and managerial principals in managing ecosystems to produce, restore, or sustain ecosystem integrity and desired conditions, uses, products, values, and services over the long-term.

Ecosystem Sustainability - The ability to sustain diversity, productivity, resilience to stress, health, renew-ability, and/or yields of desired values, resource uses, products, or services from an ecosystem while maintaining the integrity of the ecosystem over time.

Ecotone - A transition between two or more biotic communities.

Ecotype - A locally adapted population of a species which has distinctive limit of tolerance to environmental factors; a genetically uniform population of a species resulting from natural selection by the special conditions of a particular habitat.

Endangered Species - A species which is in danger of extinction.

Endemic - Restricted to a specific region or locality.

Environment - The complex of climatic, soil and biotic factors that act upon an organism or ecological community and ultimately determine its form and survival.

Environmental Change - A shift in the rate or timing of a physical process or a shift in state of physical or biotic character.

Erosion - The group of processes whereby earthy or rock material is worn away, loosened or dissolved and removed from any part of the earth's surface. It includes the processes of weathering, solution, corrosion, and transportation. Erosion is often classified by: the eroding agent (wind, water, wave, or raindrop erosion); the appearance of the erosion (sheet, rill, or gully erosion); the location of the erosional activity (surface, or shoreline); and/or by the material being eroded (soil erosion or beach erosion).

Erosion Hazard Rating - A relative (not absolute) rating of the potential for soil loss due to sheet and rill erosion from a specific site. Commonly used to address erosion response expected from a given land management activity. Ratings are the result of a cumulative analysis of the following factors: soil, topography, climate, and vegetative and protective cover.

Eyrie - A raptor's cliff nest, such as a peregrine falcon.

Exotic Species - Non-native species which occur in a given area as the result of deliberate or accidental introduction of the species from a foreign country.

Fault Zone - a fault that is expressed as a zone of numerous small fractures.

Fauna - All animals, including birds, mammals, amphibians, reptiles, fish and vertebrates (clams, insects, etc.).

Features - Items on the landscape which can be visited and are measurable, including both natural and human-made or altered items. Examples of features are created openings, roads, stand structures, ponds, and stream channels.

Flora - All plants, including trees, shrubs, forbs, and grasses, and considered as a whole.

Fragmentation - Breaking up of contiguous areas into progressively smaller patches of increasing degrees of isolation.

Frequency - How often a particular disturbance process is likely to happen at a given intensity and severity within the subbasin. Frequency is not necessarily tied to the event happening on a particular piece of ground.

Fuel Loading - The amount of combustible material present per unit of area, usually expressed in tons per acre.

Fuels - any material capable of sustaining or carrying a forest fire, usually material, both live and dead.

Gap Analysis - Process to determine distribution and status of biological diversity and assess adequacy of existing management areas to protect biological diversity.

Guild - A group of species that have similar habitat requirements. Can also be known as an assemblage.

Habitat Type - The collective land area in which one vegetation type is dominant or will come to be dominant as succession advances.

Habitat Connections - A network of habitat patches linked by areas of like habitat. The linkages connect habitat areas within the watershed to each other and to areas outside the watershed. These connections include riparian areas, mid-slopes, and ridges.

Home Range - The geographic area within which an animal travels to carry out its activities.

Impact - A negative environmental change. The value judgement of "negative" is generally construed to mean that conditions or processes are moving away from desired states.

Intensity - Aerial extent of a given disturbance event, such as acres or miles; how many features are affected. This definition differs from the term *fire intensity*.

Integrated Resource Management - The simultaneous consideration of ecological, physical, economic, and social aspects of lands, waters, and resources in developing and carrying out multiple-use, sustained-yield management.

Issue - Refers to a topic, a subject, a category, or a value which is registered by a person as something in which they have a high level of interest. Used synonymously with the term "concern". Identification of issues can occur through formal solicitation, content analysis of publication and periodicals, or informal communications.

Key Questions - Questions that Watershed Analysis attempts to answer. These are the interdisciplinary team's expectations for the analysis.

Landscape - The mixture of topographic, vegetative, and biologic attributes within an area. An area composed of interacting and interconnected patterns of habitats, that are repeated because of geology, land forms, soils, climate, biota, and human influences throughout the area. Landscape structure is formed by patches, connections, and the matrix. Landscape function is based on disturbance events, successional development of landscape structure, and flows of energy and nutrients through the structure of the landscape.

Landscape Unit - A continuous geographic area with fairly consistent landform and vegetation communities.

Linkage - Route that permits movement of individual plant (by dispersal) and animals from a landscape Unit and/or habitat type to another similar Landscape Unit and/or habitat type.

Mass Wasting - A general term for the dislodgment and downslope transport of soil and rock material under the direct application of gravitational body stresses. In contrast to other erosional processes, the debris removed by mass wasting is not carried within, on or under any other medium. Mass wasting includes many processes, including relatively slow displacement, such as creep, or rapid movement such as rock falls, debris avalanches, or debris torrents.

Metapopulation - A relatively discrete collection of individuals that interact on a genetic basis; the potential gene pool for a given population of a species, such as Snake River sockeye salmon.

Microsite - A rock outcrop, snag, seep, stream pool, or other small scale feature that is unique in character.

Monitoring - To watch, observe, or check, especially for a specific purpose, such as to keep track of, regulate, or control.

Multicohort Stands - Stands where component trees arose after two or more disturbances, of which only the first disturbance was major and the others minor.

Natural Range of Variability - The spectrum of conditions possible in ecosystem composition, structure, and function considering all factors.

Old Growth - A stand of multiple cohorts and size classes, dominated by large, old trees. If relatively disturbance independent, then comprised mostly of late seral species, such as the climate climax species. If relatively disturbance dependent, then compromised mostly of early seral species.

Peak Streamflows - The highest level of streamflow in response to a rainstorm or period of snow melt.

Physical Processes - The rate and timing of the interaction of biotic and abiotic ecosystem components.

Plant Association - A potential natural plant community of definite floristic composition and uniform appearance.

Pool Frequency - The number (occurrence) of pools or a certain size pools within a general or selected stream reach.

Province - A continuous geographic area wherein species composition, both plant and animal, is more homogeneous than between adjacent areas.

Range of Variability - (Natural Variability, historic Variability) - The spectrum of conditions possible in ecosystem composition, and function considering both temporal and spatial factors.

Refugia - Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e., endemic populations). FEMAT

Rehabilitation - Returning of land to productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.

Resilience - The ability of an ecosystem to maintain diversity, integrity and ecological processes following disturbance.

Restoration - The process of restoring site conditions as they were before a land disturbance.

Riparian Ecosystem - Ecosystems transitional between terrestrial and aquatic ecosystems. Streams, lakes, wet areas and adjacent vegetation communities and their associated soils which have free water at or near the surface.

Riparian Reserve - The area encompasses streams, lakes, and wetlands and is designed to protect aquatic and riparian functions and values. The Riparian Reserve is a function of site characteristics, physical processes linked to the area, and the type and timing of activity proposed.

River Basin Analysis - An area, defined by physical boundaries, in which all surface water flows to a common point. River basins are associated with large river systems and are typically 1000s of a square miles in size.

SCCA, Species and Community Conservation Analysis 1994 - An analysis project undertaken on the Mt. Hood National Forest in 1993 to develop a methodology for synthesizing existing information so Forest Plan analysis and planning can be accomplished across disciplines on an ecological basis. SCCA also compiled a corporate database of existing information in a retrievable and useable way on distribution and habitat relationships of plants, fish, wildlife, invertebrates, and human use, and create habitat/community maps. Gaps in knowledge were also identified. The project also developed an analysis procedure that would allow the Forest to design and analyze alternatives for species and community diversity, including a Forest-wide GAP analysis to identify areas of high species diversity, and species and communities at risk. Finally, the SCCA developed a process to cover multiple scales appropriate to the species, habitat or community being analyzed. It tiered the analysis to Regional approaches such as GAP, REAP, SAT, NASA Landscape Pattern Analysis Project, and the Ecosystem Management Assessment Working Group (post-forest Conference group).

Sediment - Fragmentation material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies. (USFS, 1960)

Sensitive Species - A species not formally listed as endangered or threatened, but thought, by a Regional Forester, to be at risk.

Seral - A biotic community which is developmental, transitory stage in an ecological succession.

Seral Stage - A biological community viewed as a single developmental or transitional stage in an ecological succession.

Severity - How drastically a disturbance event changes a given feature or series of features. This definition differs from the term *fire severity*.

Single Cohort Stand - A group of trees regenerating after a single major disturbance.

Sinuosity - Meander length and pattern of a stream. Stream length divided by valley length.

Spawning Sites - Graveled areas within a stream system having the appropriate attributes, i.e. dissolved oxygen, water depth, water velocity, water temperature, substrate composition, and cover that are selected as suitable for spawning by adult fish.

Special and Unique Habitats - A rock outcrop, snag, seep stream pool, and other environmental features small in scale but unique in character.

Stochastic - Random or uncertain variation.

Stratification - The delineation of areas within a watershed which will respond relatively uniformly to a given process or set of conditions.

Stream Order - A method of numbering streams as part of a drainage basin network. The smallest unbranched mapped tributary is called first-order, the stream receiving the tributary is called second-order, and so on. It is usually necessary to specify the scale of the map used. A first-order stream on a 1:62,500 map, may be third-order stream on a 1:12,000 map. Tributaries which have no branches are designated as of the first order, streams which receives only first-order tributaries are of the second-order, larger branches which receive only first-order and second-order tributaries are designated third-order, and so on, the main stream being always of the highest order.

Succession - An orderly process of biotic community development that involves changes in species, structure and community processes with time. It is reasonably directional and therefore, predictable.

Sustainability - The ability to sustain diversity, productivity, resilience to stress, health, renewability, and/or yields of desired values, resource uses, products, or services from an ecosystem while maintaining the integrity of the ecosystem over time.

Terrestrial - Living primarily on land rather than in water.

Terrestrial Ecosystem - An interacting system of soil, geology, topography with plant and animal communities.

Threatened Species - A species which is likely to become an endangered species.

Threshold of Concern (TOC) - Used in cumulative watershed effects analyses to describe the point (in terms of percent equivalent road area) where the risk of watershed degradation is significant if mitigation measures are not employed.

Transient Snow Zone - The area between 2,500 and 5,000 feet elevation subject to rain-on-snow events during winter months.

Trigger - A critical threshold or an event that precipitates in the need for management action.

Underburning - The prescribed use of fire beneath a forest canopy.

Viability - The likelihood of continued existence in an area for some specified period of time.

Watershed - A region or area bounded peripherally by a water parting feature and draining ultimately to a particular watercourse or body of water. There are many watersheds within a river basin. Watershed areas range from 20 to 200 square miles in size.

Watershed Analysis - development and documentation of a scientifically based understanding of the processes and interactions occurring within a watershed in order to make more sound management decisions.

Weir - An obstruction placed across a stream thereby causing the water to pass through a particular opening.

Wetland - An area at least periodically wet or flooded, an area where the water table stands at or above the land surface.

Vegetation Classification Scheme for Stands in Mill Creek Watershed

Cathedral - Semi-open to semi-closed stands dominated by large, widely-spaced trees. Overstory trees are mostly shade tolerant species and 20" DBH or greater. Tree crowns nearly touching to just overlapping. Canopy closure ranges from 40-80%. Canopy either single layered or two-layered. If tree regeneration is present, then comprised of a mix of shade intolerant and shade tolerant species generally less than 5" DBH and canopy closure of less than 25%. Understory dominated by grasses, forbs, or shrubs. Dependent on semi-frequent underburning to persist. Typical OLD GROWTH structure type in the Transition Zone and upper end of Eastside Zone. May also be present in the Crest Zone.

Collapsing - Stand with high levels of mortality due to insect and/or disease attack. Canopy closure decreasing, grass, forb, shrub, and tree regeneration usually increasing. Very high loadings of downed woody material. Usually MID-to LATE SERAL in all climate zones.

Fire Exclusion Multistory - Dominated by ponderosa pine, Douglas fir, grand fir. Stand age <150 years. Trees >20" DBH. Canopy layers are deep or layered (from stand exam heights). This type is mostly found in the zone of frequent understory burning, so is currently moving outside the Range of Natural Conditions)RNC).

High Density Stagnating - Found in either the Stem Exclusion or Mature Stem Exclusion stages. The combination of stand density and either species mix or stand age has resulted in the virtual cessation of tree growth. Canopy closure often near 100%. Very high densities in low diameter classes, from air photos and stand exams. Dominant trees becoming flat-topped. No understory grasses, forbs, or shrubs are present. Downed woody loadings relatively high and increasing. Stand at high-risk of epidemic levels of disease, defoliators, bark beetles, or some combination, and of stand-replacing fire. Disturbance is required for the stand to move to the next structural stage. EARLY to MID-SERAL in Crest and Transition zones.

Late Seral Multistory - Two and three-layered stands dominated by shade intolerant species. Total canopy closure ranges from 60-100%. Overstory layer consists of a mix of shade intolerant and shade tolerant species usually greater than 20" DBH and with a canopy closure of 50-80%. Midstory layer consists of mostly shade tolerant species 5-19" DBH with a canopy closure of 10-30%. The understory tree layer consists of mostly shade tolerant species less than 5" DBH with a canopy closure of 10-30%. Stand somewhat broken with small openings that support tree regeneration, shrubs, and forbs. Sun flecks common. Large downed woody loadings variable but can be quite high with numerous large downed logs and trees. Typical OLD-GROWTH structure in the Crest Zone. LATE SERAL in the crest and Transition zones.

Mature Stem Exclusion - Stand age <150, usually dominated by shade intolerant species but with shade tolerant species represented. Canopy closure of 70-90%, heights for dominate diameter classes within about 30 feet of each other (single canopy), and dominant and co-dominant trees usually 9-20" DBH. Shade intolerant species are mostly in the dominant and co-dominant crown position. Shade tolerant species are mostly in the co-dominant and intermediate crown position. Canopy generally single-layered or somewhat two-layered. Generally consists of dense stands that may have been salvaged or high graded in the past. Understory usually contains few grasses, forbs, or shrubs. MID-SERAL in Eastside and Transition zones.

Mid-Seral Multistory - It is a similar structure type to Fire Exclusion Multistory, but has more western larch, subalpine fir, western hemlock, englmann spruce. Essentially these are areas outside the zone of frequent understory burning, so not moving outside the Range of Natural Conditions.

Late Seral Multistory - Two and three-layered stands dominated by shade tolerant species. Total canopy closure ranges from 60-100%. Overstory layer consists of a mix of shade intolerant and shade tolerant species usually greater than 20" DBH with a canopy closure of 50-80%. Midstory layer consists of mostly shade tolerant species 5-19" DBH with a canopy closure of 10-30%. The understory tree layer consists of mostly shade tolerant species less than 5" DBH with a canopy closure of 10-30%. Stand age >=150years. Stand somewhat broken with small openings that support tree regeneration, shrubs, and forbs. Sun flecks common. Large downed woody loadings variable but can be

quit high with numerous large downed logs and trees. Almost none of the Ponderosa pine stands fell within this category. Typical OLD GROWTH structure in the Crest Zone. LATE SERAL in the Crest and transition zones.

Open Intolerant Multistory - One to two-layered open to semi-open stands of medium sized trees. Ponderosa pine or ponderosa pine and Douglas-fir dominate; Oregon white oak often present. Overstory comprised of trees 6-20" DBH with 30-60% (from air photos) canopy closure. Ponderosa pine has not developed yellow bark. If Oregon white oak or conifer regeneration is present, then stand is two-layered. Oregon white oak crowns variable, but often large and spreading. Understory crown closure generally less than 30%. Grass-forb understory with some scattered shrubs present. Stands may have been thinned or high-graded. MID-SERAL in Eastside and Transition zones.

Open Parklike - One and two-layered stands with a canopy closure of 20-50% (from air photos), clumpy and dominated by ponderosa pine. If Oregon white oak is common, the stand is considered two-layered. Douglas-fir may be somewhat common to common. Grand fir may be present. No other conifer species are present. Stands consist of even-aged clumps of conifers and clumps to scattered individual conifers and oak of varying ages. All age classes of ponderosa pine are present, but large, "yellow" pines appear to dominate (large trees mostly 20" DBH and larger). Crowns on oak trees variable, but mostly large and spreading. Understory of grass and forbs or grass, forbs, and shrubs. Very light downed woody loadings and few large downed logs and trees. Depends on disturbance to maintain presence. Typical OLD GROWTH structure in Eastside Zone and lower end of the Transition Zone. MID-SERAL in Eastside and Transition zones.

Pine-Oak High Density - Two layered stands with scattered large ponderosa pine in the overstory and dense ponderosa pine and oak in the understory. Overstory dominated by scattered individual trees or small clumps of ponderosa pine generally less than 15" DBH with 40% or less canopy closure. Understory generally continuous ponderosa pine generally less than 12" DBH with 40% or greater canopy closure. If present, oak has small, narrow crowns, except on edges of openings. Understory of pine needles and scattered clumps of grass, forbs, or shrubs. Small pines may have ceased growing. LATE-SERAL in the Eastside Zone.

Riparian Hardwood - Stands dominated by tree-form hardwoods, primarily black cottonwoods, alders, and willows and occasional conifer species and maintained by fire, beaver activity and flood scouring of streambanks. Canopy closure from conifers less than 50%. EARLY SERAL.

Riparian Conifer - Stands dominated by conifers with an occassional cottonwood tree or cottonwood tree patch. Dense shrub layer of willow, alder, and a high diversity of other species. LATE SERAL.

Stand Initiation - Created opening in a forest matrix with trees less than 5" DBH and canopy closure variable. An overstory may be present as long as the canopy closure of the overstory is 30% or less. Includes clearcuts, seed tree cuts, and shelterwood cuts as well as openings created by insects, disease, fire, or other natural events. Grasses, forbs, or shrubs common and may dominate. EARLY SERAL in all climate zones.

Stem Exclusion - Young stands usually comprised of shade intolerant species with canopy closure of 70-90%. Trees usually 5-9" DBH. Canopy is single-layered. Generally consists of plantations and "dog hair" stands of natural regeneration. EARLY SERAL in Crest and Transition zones.

Understory Reinitiation - Semi-open to semi-closed stands of both shade intolerant and shade tolerant species. Stand is distinctly two-layered with shade intolerant species dominating the overstory and a mix of shade intolerant and shade tolerant species in the understory. Overstory trees generally 12" DBH or greater with canopy closure of 15-20%. Understory trees generally less than 5" DBH with a canopy closure of less than 25%. Understory grasses, forbs, or shrubs are common. Usually occurs between the Stem Exclusion stages and between the Mature Stem Exclusion and Late Seral Multistory stages. MID- to LATE SERAL in the Crest and Transition zones.

Woodland - Very open areas with scattered ponderosa pine and Oregon white oak or Oregon white oak. Canopy closure usually less than 25% if ponderosa pine present or less than 40% if only Oregon white oak present. Site often dominated by grass and forbs or brush. Sites differ from Open Intolerant Multistory in that they are incapable of supporting many trees. Sites most often scabby with shallow or rocky soils or at the lower limits of tree growth. LATE SERAL in Eastside Zone, Special Habitat in Transition Zone.

Appendices

Appendix A
Geology

MILL CREEK WATERSHED
LANDSLIDE ANALYSIS

GEOMORPHOLOGY AND GEOLOGY

Mill Creek watershed is oriented in a southwest to northeast direction. Its headwaters are located approximately 18 miles south of Hood River at Mill Creek Buttes, where the elevation is roughly 4900 feet above sea level. The distal end of the watershed is located at The Dalles where Mill Creek joins the Columbia River at an elevation of just over 100 feet. The watershed is bordered to the west by the East Fork Hood River watershed, to the south and east by Mile Creeks watershed, and to the north by an assemblage of small tributaries of the Columbia.

Paralleling Mill Creek is the somewhat hidden Dalles Syncline, an elongated down-fold of the underlying bedrock. Forming Mill Creek Ridge and trending in a somewhat more northerly direction is the Mill Creek Ridge anticline, a relatively narrow and sharp upfold that may have formed as a result of thrusting from nearby Chenoweth Fault. Although the Chenoweth Fault lies north of the watershed, three minor faults are exposed within the watershed where they cross Mill Creek, and outside the watershed where they cross Brown Creek. The vertical displacement of one of these faults is approximately 50 feet at Mill Creek, while displacement of another is closer to 100 feet (NGS, Inc. 1995). The watershed is underlain by thousands of feet of Columbia River Basalt flows. Individual flows range in thickness from tens of feet to a few hundred feet. Several important interbeds are present between flows, and it is from these locations that groundwater is typically sought. The Columbia River Basalt is overlain by up to 1000 feet of volcaniclastic strata known as the Dalles Formation.

Glacial floods affected the lower portion of the watershed dozens of times during the Pleistocene. The Missoula Floods were of such magnitude that flood waters at The Dalles were impounded as much as 1200 feet. The flood waters scoured the landscape below this elevation and left extensive glaciofluvial deposits throughout the lower portion of the watershed. These "deposits generally become thinner and finer with increasing elevation and distance from the Columbia" (NGS, Inc. 1995).

GEOLOGIC UNITS

Sixteen geologic units have been identified during previous geologic mapping of the Mill Creek watershed. The units are briefly described below in their approximate order of occurrence, from youngest in age to oldest. Information is from Beaulieu (1977) and Sherrod and Scott (1995).

Surficial Units

Qoa QUATERNARY OLDER ALLUVIUM: Unconsolidated gravel, sand, silt, and clay located above floodplains of major streams and as valley fill of smaller stream valleys; includes several terrace levels of various ages.

Qls QUATERNARY LANDSLIDE DEPOSITS: Poorly-sorted deposits of large slumps and debris slides and deep bedrock failures; generally poorly exposed and mapped on the basis of morphology. Several ancient landslides have been mapped in the watershed. The steep valley walls of Mill Creek appear to be particularly susceptible landforms.

Ql QUATERNARY GLACIAL FLOOD DEPOSITS: Unconsolidated gravel, sand, and silt scoured from nearby upstream terrain and deposited locally in protected areas. Found in several locations in the lower portion of the watershed, typically adjacent to older alluvium at the foot-slopes of valley walls.

Qt TALUS: Blocky to platy, coarse-grained detritus, typically forming aprons below steep cliffs. One minor occurrence is found near the headwaters of the watershed at Shellrock Mountain.

Bedrock Units

Qbdr BASALTIC ANDESITE OF DOG RIVER: Medium-gray porphyritic lava that erupted from cinder cones on Hood River escarpment and flowed northeast down South Fork of Mill Creek.
QTb BASALTIC ANDESITE AND BASALT: Lava flows from vents near Dog River Springs located to the south of the watershed. Occurs in a limited area in the headwaters of the watershed south of Mill Creek Buttes.

QTv HIGH CASCADES VOLCANIC ROCK: Basaltic and andesitic flow rock, agglomerate, tuff breccia, and debris flows of High Cascades volcanic peaks. Occurs in several locations throughout the watershed.

Tia INTRUSIVE ANDESITE: Platy to blocky, very fine-grained to medium-grained lava forming sills and plugs. Found at Shellrock Mountain.

Tdm(l) DACITE OF MILL CREEK BUTTES: Hornblende dacite domes at headwaters of South Fork of Mill Creek.

Tdm(w) DACITE OF MILL CREEK BUTTES: Hornblende dacite domes at headwaters of South Fork of Mill Creek. Where mapped as Tdm(w), volcaniclastic deposits are present; elsewhere mapped as Tdm(l).

Td DALLES FORMATION: Andesitic to dacitic volcaniclastic rocks including block-ash deposits, tuff breccias, volcanic sandstones, and volcanic conglomerates. This is the most prevalent geologic unit within the watershed, and it forms the majority of the steep valley walls.

Taef ANDESITE OF EAST FORK HOOD RIVER: Andesite lava flows and minor breccia or tuff breccia. Found in limited occurrence at the extreme western edge of the watershed.

Tvs VOLCANICLASTIC ROCKS: Tuff breccia, pumiceous lapilli tuff, and minor sandstone and conglomerate. Found in the central portion of the watershed and is unconformably overlain by the Dalles Formation. Probably correlative with the Rhododendron Formation.

Tcr COLUMBIA RIVER BASALT: Flows of dense, dark-gray basaltic lava; includes pillowed lavas, tuffs, and thin interbeds locally. Found throughout the watershed and may include Tcwf and Tcgn2 members (sometimes mapped separately) listed below. The watershed is underlain by several thousand feet of this unit.

Tcwf FRENCHMAN SPRINGS MEMBER OF THE COLUMBIA RIVER BASALT: Lava flows of slightly porphyritic basalt found throughout the watershed.

Tcgn2 GRANDE RONDE BASALT: Fine-grained lava flows found throughout the watershed.

The geology units can be grouped into six general categories:

Resistant rock: Qbdr, QTb, Tia, Tcr, Tcwf, Tcgn2;

Intermediate rock: Tdm (l), Taef, QTv;

Weak rock: Tdm(w), Td, Tvs;

Alluvium: Qoa, Ql;

Talus: Qt;

Landslides: Qls.

LANDFORMS

The watershed was divided into ten general landform types based primarily on slope angle and susceptibility to landsliding of the underlying geologic unit. The table below lists the landform types, their acronyms, typical slope range in percent, relative potential for shallow mass-wasting, and relative potential for deeper mass-wasting.

Landform Type	Symbol	Typical Slope Range	DF-DS Potential	S-EF Potential
Resistant And Intermediate Rock Gental Slopes	RIRGS	0-30%	Low	Low
Resistent And Intermediate Rock Moderate Slopes	RIRMS	30-50%	High	Medium
Risistant Rock - Steep Slopes	RRSS	>50%	High	Low
Intermediate Rock -Steep Slopes	IRSS	>50%	High	Low
Weak Rock - Gentle Slopes	WRGS	0-30%	Low	Medium
Weak Rock - Moderate Slopes	WRMS	30-50%	High	High
Weak Rock - Steep Slopes	WRSS	>50%	High	Medium
Quaternary Landslide Deposits	QLD	10-60%	High	High
Alluvial Valley Bottom & Terraces	AVBT	0-15%	Low	Low
Talus	TAL	20-70%	Medium	Low

DF-DS: shallow landslides, debris flows and debris slides
S-EF: deeper landslides, slumps and earthflows

Typical landform characteristics and hazards of slope classes are as follows (Beaulieu 1977):

0 to 30 percent - landforms include valley bottoms, ridge-tops, and gentle hills; hazards are generally minimal and include stream-bank erosion, flooding, high ground water, soil creep, and slope erosion;

31 to 50 percent - landforms include valleys of major streams, volcanic accumulations, and major canyons; hazards include debris flows, debris slides, slumping, locally severe erosion potential, soil creep, and possible earflow;

>50 percent - landforms include steep canyons, talus, and bedrock outcrops approaching vertical; hazards include debris flows, debris slides, rockfall, severe slope erosion, and deep, large-scale, bedrock failures.

LANDSLIDES

The landslide potential and relative sediment delivery rating for the landform types were determined by examining aerial photographs covering the upper portion of the watershed. The results of this work are summarized in the tables below. Table I refers to the potential of a generic (any type) landslide to occur within a given landform type. Table II shows the types of mass wasting and erosion processes that are likely to occur on a particular landform. Table III lists each landform type and its relative sediment delivery rating for mass wasting. It is important to note that landslide potential and relative sediment delivery are not necessarily equivalent because of variations in delivery capability and proximity to streams. Table IV summarizes the characteristics and processes associated with each landform.

TABLE I. LANDSLIDE POTENTIAL BY LANDFORM TYPE

Resistant and Intermediate Rock--Gentle Slopes	Low
Resistant and Intermediate Rock--Moderate Slopes	Medium
Resistant Rock--Steep Slopes	Medium
Intermediate Rock--Steep Slopes	Medium
Weak Rock--Gentle Slopes	Low
Weak Rock--Moderate Slopes	Medium
Weak Rock--Steep Slopes	High
Quaternary Landslide Deposits	High
Alluvial Valley Bottoms and Terraces	Low
Talus	Medium

TABLE II. DOMINANT SEDIMENT TRANSPORT PROCESSES BY LANDFORM TYPE

DF=Debris Flow, DS=Debris Slide, EF=Earthflow, Slump, Creep, RF=Rock Fall, SE=Surface Erosion, SBF=Stream Bank Failures, IGF=Inner Gorge Failures

Landform	DF	DS	EF	Slump	Creep	RF	SE	SBF	IGF
RIRGS	L	L	n/a	L	L	n/a	M	L	n/a
RIRMS	M	M	n/a	M	L	M	M	M	M
RRSS	H	H	n/a	L	M	H	H	H	H
IRSS	H	H	n/a	L	M	H	H	H	H
WRGS	L	L	L	L	L	n/a	M	M	n/a
WRMS	M	M	M	M	M	M	H	H	M
WRSS	H	H	L	M	M	H	H	H	H
QLD	M	H	M	M	M	n/a	M	H	M
AVBT	n/a	n/a	n/a	L	L	n/a	M	H	M
TAL	L	M	n/a	n/a	L	L	n/a	L	M

TABLE III. RELATIVE SEDIMENT DELIVERY BY LANDFORM TYPE

Resistant and Intermediate Rock--Gentle Slopes	Low
Resistant and Intermediate Rock--Moderate Slopes	Medium
Resistant Rock--Steep Slopes	High
Intermediate Rock--Steep Slopes	Medium
Weak Rock--Gentle Slopes	Low
Weak Rock--Moderate Slopes	Medium
Weak Rock--Steep Slopes	High
Quaternary Landslide Deposits	High
Alluvial Valley Bottoms and Terraces	High
Talus	Low

TABLE IV. LANDFORM CHARACTERISTICS AND ASSOCIATED PROCESSES

Associated Rock Types:

Resistant Rock: fine-grained basalt and basaltic andesite flows, slightly porphyritic lava with minor flow breccia, basaltic and andesitic/dioritic intrusions;

Intermediate Rock: basaltic, andesitic, and dacitic flow rock, agglomerate, minor breccia or tuff breccia, and minor indurated debris flow deposits from High Cascades volcanic peaks;

Weak Rock: andesitic to dacitic volcaniclastic rocks including block-ash deposits, tuff breccias, volcaniclastic sandstones and conglomerates, volcaniclastic deposits within dacite flow rock, pumiceous lapilli tuff, ash-flow tuffs;

Alluvial Valley Bottoms and Terraces: generally sorted deposits of silt, sand, and gravel; includes Pleistocene flood deposits and material scoured from nearby uplands;

Quaternary Landslide Deposits: unsorted deposits of weathered detritus from adjacent formations;

Talus: blocky to platy, coarse-grained detritus from underlying formations;

Slope-Forming Processes:

Resistant Rock: lava flows, regional uplift, fluvial erosion, debris flows, debris slides, surface erosion, creep, possible thin loessial deposition;

Intermediate Rock: lava flows, regional uplift, fluvial erosion, debris flows, debris slides, surface erosion, creep, possible thin loessial deposition;

Weak Rock: minor lava flows, regional uplift, fluvial and glacial erosion, debris flows, debris slides, slumps, surface erosion, creep, possible thin loessial deposition;

Alluvial Valley Bottoms and Terraces: peak-flow deposits, stream-bank failures, surface erosion;
Quaternary Landslide Deposits: large-scale slumps and debris slides, minor debris slides and surface erosion within the slide mass, possible high-magnitude earthquakes;

Talus: glaciation, frost heave, debris slides, rock creep, other freeze-thaw processes;

Sediment Delivery Mechanisms:

Resistant Rock: stream-bank failures, debris flows, debris slides, surface erosion, creep;

Intermediate Rock: stream-bank failures, debris flows, debris slides, surface erosion, creep;

Weak Rock: stream-bank failures, debris flows, debris slides, slumps, surface erosion, creep;

Alluvial Valley Bottoms and Terraces: stream-bank failures, surface erosion;

Quaternary Landslide Deposits: stream-bank failures, debris slides, surface erosion;

Talus: debris slides, possible stream-bank failures, rock creep, subsurface erosion of fines.

LANDSLIDE DISCUSSION

Like many watersheds in the Cascade Mountains, the key factors that contribute to landslides in Mill Creek Watershed are steep slopes, abundant precipitation, and weak geologic formations. However, unlike watersheds west of Mt. Hood and the Cascade crest, Mill Creek watershed receives only about 15 to 45 inches of precipitation per year. (Mean precipitation at The Dalles over the past five decades is 14.7 inches.) In addition, only a small percentage of the watershed consists of steep slopes, and many of these are comprised of rock that is relatively resistant to slope failure. Consequently, Mill Creek watershed is one of the more stable watersheds within the Mt. Hood National Forest. Nevertheless, landslides do occur, and they tend to do so in locations where one or more of the above conditions is met.

Inner gorges and colluvial hollows are one such location having a predisposition toward landsliding. Tributary channels may also be included in this category since they often act like colluvial hollows and collect debris introduced by headward erosion or deposited by stream-bank failures. Episodes of peak flow associated with large storms or rain-on-snow events typically mobilize this debris in either of two ways. If a debris flow is triggered at the headwaters of the tributary, it may collide with and mobilize the channel debris as it passes. In the absence of a debris flow, peak flow volumes must be sufficiently large to entrain the channel debris as a hyperconcentrated flood or possibly a debris flow. Ephemeral streams may be particularly disposed to failure by debris flow because they act as a repository for debris of all kinds when their channels are dry. Under such conditions, the debris may be quite stable, but when the channel again carries water, these seasonal deposits may be mobilized.

During the landslide inventory, 36 landslides were identified (TABLE V). Of these, 31 occurred within the period of photo record which dates back to 1946. The 5 remaining landslides are considered to be ancient and are only visible because their scarps and/or deposits are quite large. Of the recent landslides, 20 are debris flows, 7 are debris slides, 1 is rockfall, and 3 are stream-bank failures. Separating these landslides by land use indicates that 2 are associated with roads, 1 with non-forested land, and the remaining 28 appear to be associated with unmanaged forest land. In addition, 30 of these appear to have delivered sediment to streams. It is possible that more landslides than noted are associated with land management impacts, but interestingly, despite the fact that several of the steeper slopes within the watershed have been logged, very few landslides are visible on air photos. It is important to note, however, that any associations made between landslides and management activities are that and nothing more; the actual causes of the landslides are not known.

TABLE V, LANDSLIDE TYPES AND ASSOCIATIONS

36 landslides identified
- 5 ancient
- 31 recent
  - 20 debris flows
  - 7 debris slides
  - 1 rockfall
  - 3 stream bank failures
  - 31 total

  - 2 associated with roads
  - 1 associated with non-forested land
  - 28 associated with mature forest
  - 31 total

EROSION AND FLOODING

A majority of the first- and second-order stream channels in Mill Creek Watershed are subject to severe stream-bank erosion and flooding. Beaulieu (1977) describes these hazards as follows:

Stream-Bank Erosion: Undercutting and caving of river and stream banks by stream action; restricted primarily to outer bends of meanders on larger streams; characterized by steep cut bank walls, deep water near cut banks, and actively growing point bars;

Torrential Flooding: Characterized by rapidly flowing water with high channel and stream-bank erosion potential in narrow canyons with little or no floodplain; generally restricted to short, high-gradient streams flowing through steep terrain of high relief; channel deposits generally very coarse, angular, and poorly sorted;

Lowland Flooding: Less erosive flooding of areas for which a flood plain is typically present; channel deposits are sorted and contain a wider range of particle sizes; areas delineated on the basis of surficial unit distribution, soils, landforms, driftwood, and protective structures;

Slope Erosion: Favored in areas with high slope gradients, lengthy slopes, sandy or silty soils, lack of consolidation, and absence of vegetation or other protective cover.

ADDITIONAL COMMENTS AND OBSERVATIONS

Invariably, north-facing valley walls are better vegetated than valley walls with other aspects. South-facing valley walls in particular are often completely devoid of conifers. This is partly a result of late-lying snowpacks and an increased period of water availability into the spring months. Regarding the angle of incidence of the sun's rays on these steeply-sloping landforms, each additional degree of slope toward the sun is equivalent to a southward shift of approximately 70 miles in latitude. Slopes angled more toward the sun receive more direct insolation and tend to dry out much more quickly. In fringe environments where precipitation is low to begin with, these slight changes in soil moisture and growing season manifest themselves in ways that are readily apparent in terms of vegetative cover. In turn, slopes where vegetation is sparse appear to have a greater propensity for landsliding. Indeed, south-facing slopes in North Fork Mill Creek valley are severely dissected by channels sharing debris flows and ephemeral streams. The deposits of these debris flows appear to be coarse-grained and have very short runout zones, even after the narrowness of their respective valleys is taken into consideration.

Although debris flows were the leading inventoried landslide, stream-bank failures are probably the most common type of landslide in the area. Judging from field work conducted elsewhere in the Mt. Hood National Forest, stream-bank failures appear to be vastly under-represented in the landslide inventory. This is of course because stream-bank failures tend to be small and are often concealed by riparian vegetation. They are, therefore, difficult to detect on aerial photographs at a scale of 1:12,000. Rough estimates indicate that stream-bank failures producing up to 50 cubic yards of debris can be concealed from air photo observation by the riparian canopy. In addition, while debris flows and debris slides tend to have return intervals of a few years, stream-bank failures have much shorter return intervals, and may account for a majority of the sediment delivered to streams by landslides.

Though not mapped, it is probable that loess has been deposited over at least some portions of the lower watershed. East of the watershed loess deposition increases. Along Tygh Ridge, for example, the average thickness ranges from 2 to 4 feet depending on slope angle. Within steep canyons, however, the deposits are substantially thinner. A dense, clay-rich paleosol exists beneath loess deposits where slopes are gentle, and may act in concert with underlying bedrock, impeding infiltration and contributing to abrupt increases in pore water pressure. The extent to which similar conditions exist within Mill Creek watershed is unclear, but where loess is present, slope erosion and shallow slope failures are a concern.

Bands of vegetation are present where interlayer groundwater breaches the surface along steep canyon walls. The effect is highly noticeable and produces a "tiered" appearance consisting alternately of lush vegetation and savanna-

like grasses and shrubs. With the implications of water availability so obvious, planned management activities having the potential to disrupt the natural conditions should be closely scrutinized.

Throughout the watershed and in neighboring areas, groundwater appears to have been abundant historically. More recently, however, with the steady development of water-intensive agriculture (orchards and row crops), groundwater levels throughout the region and within at least one basalt aquifer along Mill Creek have showed constant decline (NGS, Inc. 1995).

Beaulieu (1977) also discusses potential future mass movement within the watershed and surrounding areas: "In addition to active slides, areas of highest potential for future mass movement through improper or changing land use include faults in Tcr (Columbia River Basalt), moderately sloping to steeply sloping or gently dipping Tpd (Dalles Formation) in areas of increased infiltration, cuts in deep talus, steep slopes of unconsolidated material, and steep slopes in devegetated areas."

Certain geologic conditions within the watershed are inherently unstable and merit special attention during field investigations. Some of these areas are listed below.

1. Contacts between weak and resistant rock. Changes in permeability at these contacts often result in springs or shallow groundwater tables. Altering the groundwater conditions in these areas can trigger debris slides and debris flows. Important contacts include the following:

   Contacts between weak rock (WRSS) and resistant rock (RRSS) on steep slopes.

   Contacts between the Dalles Formation (Td) and more resistant underlying flows of Columbia River Basalt r rock (Tcr, Tcwf, Tcgn2).

   Contacts between other volcaniclastic rocks (Tvs) and more resistant underlying flows of Columbia River Basalt rock (Tcr,Tcwf, Tcgn2).

2. Contacts between resistant lava flows. Springs and seeps often breach the surface where these interbeds have been exposed, typically along the steep canyon walls of Mill Creek.

3. Around the edges of intrusions (Tia). The heat from these intrusions has often altered and weakened the adjacent rock making it more prone to mass wasting.

4. Along the margins of dikes and sills. Similarly to intrusions, the heat associated with dike and sill emplacement tends to alter and weaken the adjacent rock making it more prone to mass wasting. Dikes and sills are not shown on the maps.

5. Along stream banks within the landform types RRSS, IRSS, WRSS, or similar landforms. Slumps, debris slides, and stream-bank failures may occur next to down-cutting or laterally-cutting streams. Although these failures can contribute significant amounts of sediment to adjacent streams, they are often too small to be visible on aerial photographs.

6. On slopes with gradients in excess of 60 percent where shallow soils overlie less permeable materials. Although these conditions may be met elsewhere, they are most common on landform types RRSS, IRSS, WRSS. These conditions are prone to shallow planar failures.

7. Along the margins of Quaternary landslide deposits. Changes in groundwater levels near these margins often trigger debris slides, debris flows, and slumps.

8. On the scarps of ancient landslides. These areas are steep, have shallow soils, and are prone to debris slides and debris flows. The scarps are not designated on the maps.

9. At the headlands of tributaries with steep gradients. Historically, many such areas have experienced debris flows, and those presently filled or filling with colluvium may fail with the slightest provocation.

10. In the inner gorge locations of any steeply-sloping landform.These areas may be sites of colluvial hollows and higher than typical groundwater levels.

11. In the vicinity of fault zones on steep slopes. Increased fracturing and weathering in these areas decreases stability. These zones are not shown on the maps.

There is some overlap among the geologic conditions listed above. The presence of these conditions does not automatically mean that the area is unstable, but it does mean that the area needs to be investigated carefully by an experienced geologist, geotechnical engineer, or geomorphologist.

LIMITATIONS AND ASSUMPTIONS

1. Due to time constraints, field-checking of landslides was not possible.

2. Rates of sediment delivery were not calculated.

3. Aerial photographs were available for the upper half of the watershed only. Consequently, the landslide inventory and above discussion pertains only to this portion of the watershed. It is assumed, however, that where like geologic and hydrologic conditions exist, like processes occur.

4. Natural rates of landslide occurrence were not determined.

5. A causal relationship between land management practices and landslide occurrence could not be determined due to the nature of the analysis, a lack of field work, and the inability to control for certain factors such as the distribution of landforms and the types and locations of permissible management activities. This causal relationship, however, is well documented in the scientific literature (Swanson and Dyrness 1975; Gresswell et al. 1979; Amaranthus et al. 1985; Wolfe and Williams 1986; Neely and Rice 1990; Sidle 1992).

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Doug Smith, Tom DeRoo, Doug Anderson Mt. Hood National Forest

Appendix B
Historical

Historical Assessment
Mill Creek
Watershed Analysis

Prepared by Diane L. Lehman Turck, Archaeologist
Hood River Ranger District
October, 1996
Edited by Kathleen T. Martin, Archaeologist
Barlow Ranger District
April, 1997

Because few professional excavations have been done in this watershed, there is no recognized cultural timeline particular to the Mill Creek area. There are, however, any number of such timelines for the region. Most share enough similarity that the interrelationships are easily observable. The following sequence is for the prehistoric and historic people using this environment. Dates are approximate.

At least by 20,000 to 15,000 years ago the first humans occupied the Pacific Northwest. These low density populations are characterized as early broad spectrum foragers. Some of the first travelers residing in the area of the Mill Creek Watershed would have been subjected to the Bretz floods at a rate of one or two every century until around 12,000 years ago. These torrents would have disrupted the lives of animal and human populations, as well as removing traces of past campsites. The lower reaches of Mill Creek up to 1000 feet in elevation were scoured by the water's action. Direct evidence of Paleoindians is rare but early finds in the area include two Clovis points from The Dalles-Deschutes area and a campsite near the mouth of Fivemile Creek dating to at least 9,800 years ago and possibly several thousand years before.

As the climate became hotter and drier 8,500 to 5,500 years ago, some sections of the Mill Creek watershed may have been regularly utilized during this period. Closed canopy forest, parklands, meadows, lakes and rivers with associated riparian areas would have resources available at least seasonally.

Between 5,500 to 2,500 years ago populations developed a semi-sedentary foraging and collecting strategy, analogous to the rise of agriculture elsewhere. The warmer, drier climate during this time continued to restrict the amount of territory available to inhabitants. Certain sites frequently occupied in the Early and Late Archaic not far to the east of the watershed show little evidence of use during this time frame (Aikens 1993).

The first houses documented in the region date to between 5,500 and 5,000 years ago. All of these were semi-subterranean; the walls and roof were built over a hole dug in the ground. Two villages discovered near the north shore of the Columbia each contain over ten circular to oval housepits.

Shortly before 2,500 to 500 years ago, the climate became cooler and moister once again, with local and short term fluctuations. Plants and animals reentered areas abandoned during more severe drought conditions. Once sporadically inhabited sites near the Columbia were reinhabited and once more became important settlements. Whether descendants of the same groups or other foraging cultures reoccupied these areas, is not known.

The Bridge of the Gods Landslide, which occurred during this period, resulted in a stretch of the Columbia near Cascade Locks becoming depopulated. Before the catastrophe, only circular or oval housepits were found. Sometime after that event, rectangular housepits villages appear. Trade and immigration networks were far reaching by this time. Many sites have non-local items which could only be the result of trade over long distances.

Use of the Mill Creek watershed was also probably more intense during this time. The area around the mouth of the creek, appealing to the first Euro-American inhabitants, was likely attractive to American

Indians for many of the same reasons. With higher population densities, the Columbia River shoreline along the confluence was well occupied. Seasonal or semi-permanent villages may have been built in various locations around the mouth, on the flats, within the sheltered riparian areas and near upland prairies and meadows. Numerous trails along tributaries of Mill Creek and the waterways to the north and south ended along the ridge overlooking the East Fork Hood River Valley.

The Ethno-Historic period (starting about 500 year ago) begins with the arrival of Euro-Americans and Russians on the continent. This period is characterized by instability and disease. Because the Columbia River was a main route for travel and trade, and the Long Narrows (just east of The Dalles) was the most important trade center, all epidemics in the region passed through the area. Evidence shows that village sites were abandoned and reoccupied. Large population losses from disease were the major cause, but climate may have been a minor factor in the early part of the period. The introduction of the horse around AD 1730 presented another source of lifestyle adjustment (Jenkins and Connolly 1994), although its direct impact was felt less in this watershed than in areas to the east and south.

While other American Indian groups may have used this watershed, the groups that most commonly visited the area were probably the Hood River and The Dalles Chinookans, also known as the Wascos, and the Tenino. Although the two groups of peoples lived in villages only six miles apart, they spoke distinctly different languages. The Chinookan's dialect was related to Chinookans to the west. Tenino was one of several Sahaptan dialects which had more in common with the Nez Perce language than to that of their close neighbors.

The arrival of waves of settlers, in conjunction with some of the later epidemics, added another threat to already disrupted lifeways. Finally, following the treaty in 1855, most of the Tenino and Chinookans in the area were removed to the Warm Springs Reservation with other remnant American Indian groups. Many families did not like settled living, however, and returned to camps in areas that they had long used.

The Mill Creek watershed was one of those areas still used for several purposes. Some trails followed by early Euro-Americans were well established Indian trails, used for trade routes and as access to gathering areas. Trails going through the tributary valleys onto the ridgeline were probably used by the Chinookans and Tenino for seasonal hunting and gathering through forests, prairies and meadows along Surveyors Ridge (Murdock 1980). Seasonally, huckleberry and camas, lomatiums, beargrass and other plants, deer, elk and game of all sizes were important foods obtained in the watersheds and processed for use throughout the year. Nearby Chenoweth Flats were known as principal camas grounds, and kouse and other roots were collected along the river courses and hills around Mill Creek and surrounding watersheds (Suphan 1974). Fish were caught in tributaries and main forks of Mill Creek. Collecting and preparing each of these foods meant establishing a camp for several days. Families usually used the same fields and hearths for drying year after year. Intentional burning to keep underbrush from travel routes and to maintain huckleberry patches is well documented. Longer term camps may have been situated on the creek close to the mouth of the Columbia to take advantage of the salmon runs, or placed further back in a more sheltered location.

Peeled cedars, the bark of which was used in basketry and clothing, are also found in this watershed. Many such sites were destroyed as agricultural and other development entered the valleys and through natural mortality. Mill Creek watershed also contains a number of rock features. Some of these may have had Euro-American origins, including boundary and range markers. Others appear to correspond to descriptions of rocks altered during spirit quests for guardian spirits, for burials, for storage, training for youths, protection during battle or as hunting blinds. Very few lithic finds have been made, but the watershed also contains a dense undergrowth and thick duff.

Although there were Spanish, English and American ships off the Pacific Coast in the late 1700s, and a few actually entered the Columbia, initial exploration was done by Lewis and Clark in 1805. They saw no encampments along the southern shore of the Columbia in the vicinity of Mill Creek, which the American Indians called Quennet (various spellings), but they themselves camped there for a couple of

days in October of 1805 and again in April of 1806. They called their campsite Fort Camp or Fort Rock Camp. Although they did little investigation of the surrounding terrain, Clark noted a couple species of fish including probably steelhead as well as beaver and otter (Moulton 1989). In the 1820s, Hudon's Bay Company tried to establish a trading post to the east of the present The Dalles (Illustrated 1905), and even constructed a sawmill on Mill Creek to meet their needs (Beckham et al 1988). Short lived, the post was abandoned when the company decided to maintain its store further downstream.

Between 1800 and 1830, some of the first Euro-Americans to enter the Pacific Northwest area were missionaries. In 1838, Rev. Lee sent his nephew, Daniel Lee, and Henry Perkins to found a Methodist mission along the Columbia. They built the first permanent housing at the mouth of Mill Creek, called Wascopam, or place of the Wascos (Beckham et al. 1988). In 1843, Lee and Perkins abandoned their work and in 1847 the buildings were sold to Marcus and Narcissa Whitman. Due to arrive the next year, the Whitmans arranged for a nephew to manage at

Wascopam until then. Unfortunately the Whitmans were killed later that same year at their mission in Walla, Walla, Washington.

The mission at Wascopam was abandoned but Nathan Olney built a house and began a general store in the same location. Volunteers from the Cayuse War overwintered at Wascopam, which they named Fort Lee. Between 50 to 100 individuals quickly erected the needed buildings for their temporary quarters. Loring arrived as commander the next year, and in 1850 it became a permanent military post, renamed Fort Drum. In the process, Olney and another settler, were evicted from the property (Beckham et al. 1988).

The population of the Oregon Territory increased dramatically between 1850 and 1860 in response to the Land Acts of 1850 and 1855. In 1850, the government sent surveyors to map the area around Fort Drum. They used a large rock at the mouth of Mill Creek, called Witness or Harbor Rock, as their datum. For a short time the town was called The Landing (Illustrated, 1905) . By 1851, there was a mail route and before 1853 several houses and businesses had started. In 1854, Wasco County was created, originally containing parts of the present states of Idaho, Montana, Wyoming and Washington, besides 17 Oregon counties (Illustrated 1905; Donovan 1994). The Dalles was named the county seat and officials soon held their first meeting. In 1855, the town was platted as Dalles City and incorporated two years later.

A catalyst in the town's early growth, the fort remained important throughout the decade. Major enforcement problems listed were drunkenness and Indian control. Renamed Fort Dalles in 1853 (Donovan 1994), the commander of the fort in 1854 decided to erect new and more substantial buildings. In response, Jonas Mosier built the first substantial lumber mill in the area on Mosier Creek, and another one was built two years later on Mill Creek. The name change from Quennet to Mill Creek dates to this time. Within a few years, approximately six small lumber mills used Mill Creek for their water source.

Most families living in the Dalles City had several sources of income to make ends meet. From the 1850s until the turn of the century, many residents made some money by cutting and hauling cordwood (Beckham et al 1988). Much of it was sold or traded on the docks near Mill Creek. People also farmed. By 1854, Caleb Denton had an orchard on Mill Creek, and Calvin Brooks had started one in Brooks Meadow in addition to a dairy business. Cattle were being raised throughout the area and wheat was being grown in drier land to the east. Olney ran cattle as well as operating a ferryboat on the Deschutes. In town by the close of the decade, along with the post office, sawmills and retail outlets, there was an opera house, a fire department, a newspaper and a brewery. The Umatilla House Hotel had 128 rooms. Chinese immigrants made their first appearance before 1860.

With the influx of pioneers the government was anxious to settle the American Indians on reservations. Joel Palmer, an early partner in the Barlow Road, was one of the negotiators of the treaty with the Sahaptins and Upper Chinookans in the area. George Gibbs, another member of the team, had done some study of the Native lifestyle and insisted that fishing rights be included in the final package

(Beckman et al 1988). The 1855 treaty was signed at the Charter Oak near Mill Creek on the Denton property. Mill Creek played an important part in the development of the growing town in the 1860s. The downtown section lay just to the east of the creek, with the business district on First St. and Chinatown and the Red Light District on Second. Victor Trevitt's donation land, some of which was platted as early as 1860, was also bordered by the creek. Union St. was a link to the Columbia and a ferryboat landing was established near there. Lincoln St. was named by some of Trevitt's friends as a joke, since he was anti-Republican. In 1862, James Reynolds was granted a franchise to lay water pipe for Dalles City using Mill Creek as the source of supply. The same year he transferred the contract to Robert Pentland, who actually built and operated the system. Much of the pipe laid was done by the Chinese community. In addition, Pentland used the power of the creek to open the first flour mill in town in 1866. Only one year later, he sold the flour mill to the Dalles Woolen Mills Company. Eventually, in 1880, J.A. Smith (or Schmidt or Charles Schmidt) bought the building and converted it into a flour mill again (Illustrated 1905; Donovan 1994). Trevitt offered the Catholic Church two lots for a dollar each near Mill Creek and a wooden structure was erected there in 1861. St. Mary's Academy, a boarding and day school, was established in 1864. Well known throughout the region, it was in operation for almost a century (Donovan 1994). Oil lit street lamps extended from downtown to the second bluffline (Illustrated 1905). Several of the smaller and vernacular houses still standing near Mill Creek date to this time.

Because most transportation routes converged at The Dalles, it was pivotal in providing miners with their gear, food and transportation during the eastern Oregon and Idaho gold rush. Farmers, some of them recently arrived, could demand high prices for their goods (Illustrated 1905). During winter months many of the miners returned to The Dalles,

remaining until the following spring. This created an expanding economy where gold dust was the currency of the day. Some miners tried their luck along Surveyors Ridge, looking for gold and copper but with no real results. The financial and business impacts of the gold trade became so great that Congress appropriated money in 1865 to build a US Mint in The Dalles. Rock was quarried within the Mill Creek drainage in preparation but no further money was committed to the project and the unfinished building became Pentland's flour mill. By 1866, the eastern Oregon gold rush was over and the army closed Fort Dalles. The threat of Indians had been sufficiently reduced for years, the Civil War soldiers had been released from active duty, and turbulence of the gold rush was gone. Although The Dalles suffered a depression at the loss of income from the miners, its position on the Columbia as the hub of the transportation network remained important. The economy revitalized with an emphasis on farm products such as apples, melons, sheep, cattle and wheat (Illustrated 1905). By the end of the decade a public school was in operation as was a grange, and people who lived in town included blacksmiths, saddlers, sawmill workers, printmakers, boot-makers, wagonmakers and brewers.

Not everyone in the Mill Creek watershed lived in The Dalles. Some farmers and sawyers lived on the slopes and tributaries. Several small sawmills operated in the watershed. Closer to the headwaters, miners, farmers and trappers lived along the ridge in Gibson Prairie, near Brooks Meadow or the rough terrain in between. Some trappers like David Newell who started in the area as a bricklayer for the fort in 1858, and then hunted and trapped in Brooks Meadow into the 1860s, did other work as well including making charcoal for blacksmiths and cutting hay in the meadow. Seasonal sheepherders grazed the eastern ridgeline moving from higher to lower elevations as the weather warmed. Farmers usually had a diversity of crops and livestock, including orchards and dairy or beef cattle.

As early as the 1830s, Daniel Lee was driving cattle over Indian trails into the West Fork Hood River and the Willamette Valley beyond. Sandy-The Dalles wagon road, which crossed Mill Creek, was established as a major transportation route (Donovan 1994). On the river, important portages developed.

After the gold rush boom of the 1860s, people in The Dalles settled down to redeveloping the assets of their location and turned to agriculture and industry to redefine their economy. Stage and wagon roads

were built and steamboats carrying goods and passengers along the Columbia were popular with shippers and with ever increasing recreationalists. In response to climatic condition and market demands, wheat production bypassed that of cattle in drier acreage east of The Dalles. On Mill Creek, the woolen mill and the leather manufacturers used the products of the numerous sheep and cattle herds to their advantage. In 1875, the French brothers sold their store and started a brokerage. Within two years they had opened the first bank in The Dalles which stayed in operation until 1902.

Late in the 1870s, in the vicinity of Mill Creek, westward expansion of homes was usually in the Italianate or Queen Ann styles (Donovan 1994). A substantial wooden bridge now crossed Mill Creek to facilitate transportation. At the beginning of the decade, the population of The Dalles was between 900-1000 people.

In the watershed away from The Dalles, there were more settlers arriving this decade. Dutch Flat near the watershed was first settled as were other areas. Diversity was still present in farming with livestock, orchards, other produce, and sometimes wheat being major elements. The Hood River Valley to the west was becoming famous for its fruit and the ridgeline and parts of the Mill Creek watershed were also experimenting with fruits as well as sheep and different kinds of cattle. New roads into this part of the country from The Dalles often used old Indian trails as their foundation.

In the 1880s, rumors began of the railroad going through The Dalles and it was targeted as a central location which would connect Portland in the west with the rest of the country. Machine shops, car shops and a round house were established even before the railroad was finished (Donovan 1994). Unfortunately, the economic growth expected from the railroad did not materialize. In fact, within two years, trade from Eastern Oregon and Washington bypassed The Dalles causing a substantial loss to the economy.

In the 1880s, the community of Mill Creek was developed as a company town to harvest the timber in the Mill Creek watershed. When the company was started in 1884, the timber projected was "inexhaustible."

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Appendix C
Soils

Mill Creek Forest Soils

Prepared by John Dodd
Barlow District Soil Scientist 8-4-97

Background

Soils within the Mill Creek watershed have been mapped two times in the past 20 years. The first mapping project was completed in 1979 as part of the Mt Hood Soil Resource Inventory (SRI) at a scale of one inch to the mile (Howes, 1979). The soil information from this mapping effort is available on the forest GIS system and is used in this watershed analysis.

The second mapping project completed in 1989 focused only on the Mill Creek watershed at a scale of four inches to the mile (High, 1989). Although this mapping effort was done at a more favorable scale, the information has not been brought into a computer format and will be used as a reference document only. This document is an excellent reference for technical soil survey information and contains detailed soil profile descriptions, lab data, and suggests management guidelines by soil type.

In undisturbed conditions, soils with good vegetative cover are capable of absorbing great quantities of water and transmitting them to the stream system through the soil mantle. Overland flow and erosion would be rare, except in extreme storm events. However, when soil compaction occurs, or when vegetation and litter cover are removed, raindrops striking the bare ground can detach soil particles and seal the soil surface, resulting in reduced infiltration and increased erosion potential. If eroded soil reaches the stream system, water quality may be reduced. Since Mill Creek is a key component of a municipal watershed, water quality is a very high concern. Therefore, this report will focus on three basic questions:

- What is the extent and location of erosive soils in the watershed?
- Which soils recover relatively slowly from damage (resiliency)?
- Where are the most productive lands in terms of producing vegetation?

Soil Erosion Hazard

Soil erosion hazard is based on expected losses of surface soil when all vegetative cover, including litter, is removed. Criteria used when assigning relative ratings include evaluations of climate, slope gradient, soil texture and structure, permeability, hydrologic characteristics, and local knowledge. The 1979 SRI map units were used to delineate and categorize soil erosion hazard. This information was then stratified into high, medium, and low erosion hazard categories and mapped using the Forest GIS system. The results summarized on map, located on the proceeding pages, titled Mill Creek Erosion Hazard, shows 87% of the watershed in either a low or moderate erosion hazard. Only 13% of the analysis area is in the high category, a good portion of which is in the steep terrain of North Fork Mill Creek canyon upstream from the forest boundary. Also of interest is that virtually all of the drainage network flows through areas mapped with a moderate or high erosion hazard.

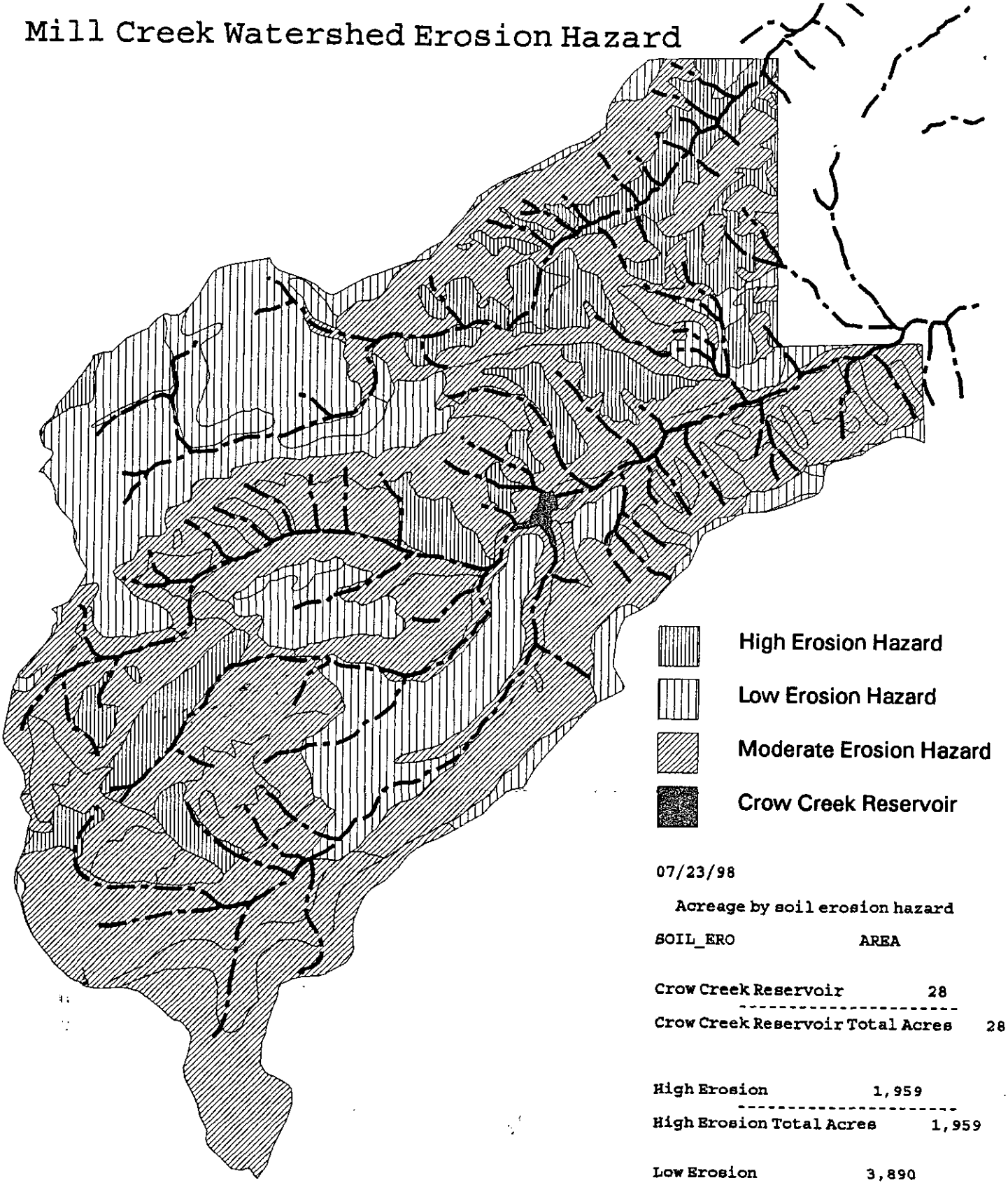
Soil Resiliency

Soil resiliency is defined as the capability of a site to recover following either natural or management related disturbance, such as intense burning where vegetation is killed or from vehicle damage. Criteria used when assigning relative ratings include compaction hazard, aspect, soil depth, precipitation range, slope, depth of soil, length of growing season and local knowledge. The 1979 SRI map units were used to delineate and categorize resiliency. This information was then stratified into low, medium and high categories and mapped using the Forest GIS system. The results illustrated on Map, on the last page of this appendix, titled Mill Creek Watershed Soil Resiliency, shows 84% of the area in either a high or moderate resiliency class. Only 16% of the analysis area is in a low resiliency class, most of which includes dry meadow or open woodland vegetation types, which recover from damage very slowly.

Soil Productivity

The question of productivity ties very closely with soil resiliency. For example, lands with lowest productivity are the ones with low to moderate resiliency due to one or more key factors holding back the optimal growth or directing the type of vegetation on a particular site (i.e. grassland vs forested). Conversely, better growing sites have moderate to high resiliency. In general, the *most* productive sites tend to be either in riparian areas or on north aspects within the 2,500 - 4,000 ft elevation band where conditions such as adequate precipitation, temperature, and deep ashy soils predominate. Soils derived from volcanic ash are considered good rooting mediums due to loamy textures and high water holding capacities. North aspects tend to have deeper soils and accumulate higher levels of organic matter (nutrient capital) than south aspects, which in turn results in higher productivity. Although riparian soils tend to include large amounts of rounded gravels and cobbles, there is usually sufficient moisture and accumulation of organic matter to allow for relatively high productivity. Southerly aspects in the watershed tend to have shallow rocky soils and harsher temperature extremes (droughty sites) and therefore produce lower vegetative biomass.

Mill Creek Watershed Erosion Hazard

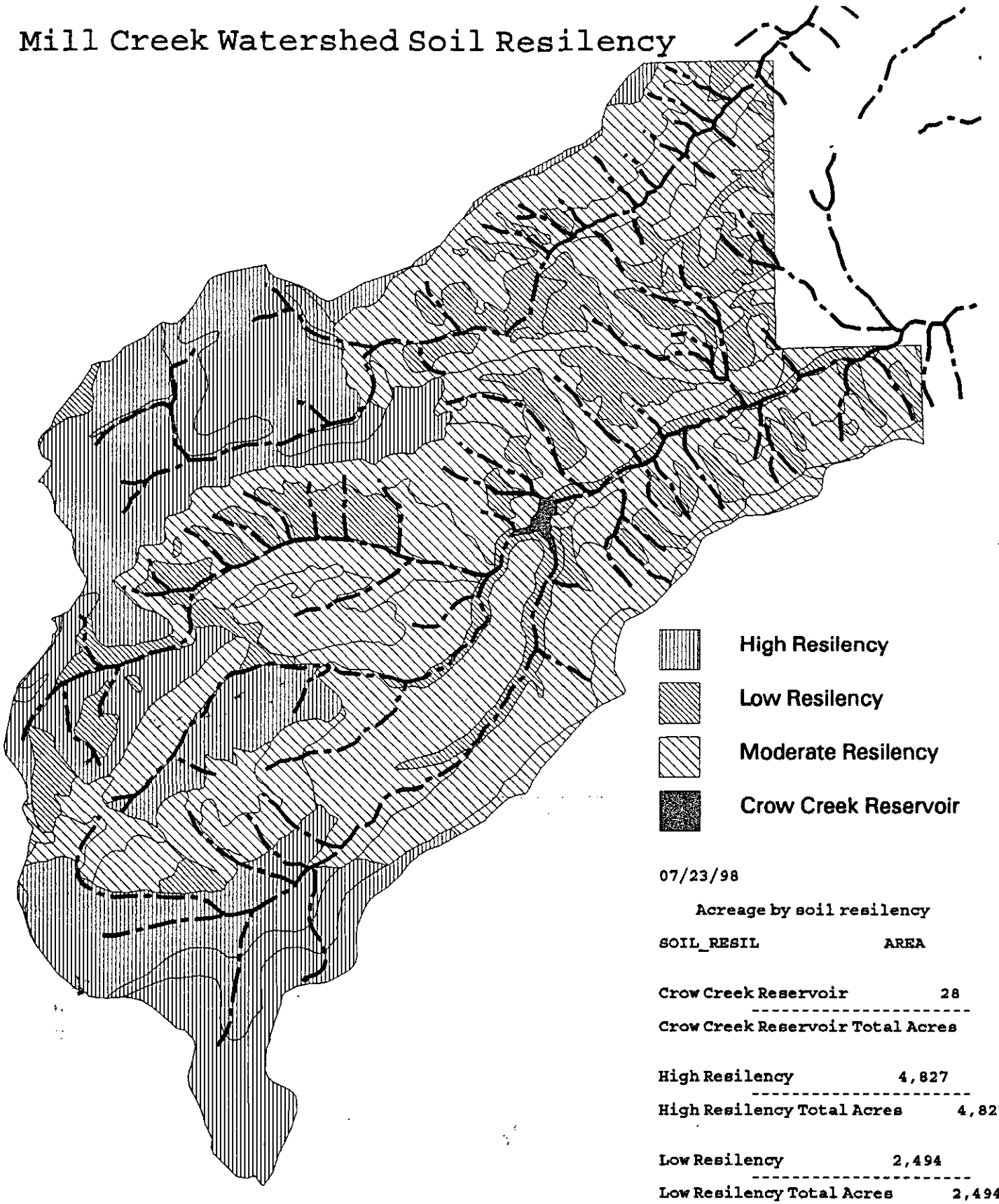


07/23/98

Acreage by soil erosion hazard

SOIL_ERO	AREA
Crow Creek Reservoir	28
Crow Creek Reservoir Total Acres	28
High Erosion	1,959
High Erosion Total Acres	1,959
Low Erosion	3,890
Low Erosion Total Acres	3,890
Moderate Erosion	9,422
Moderate Erosion Total Acres	9,422

Mill Creek Watershed Soil Resiliency



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Acreage by soil resiliency

SOIL_RESIL	AREA
Crow Creek Reservoir	28
Crow Creek Reservoir Total Acres	28
High Resiliency	4,827
High Resiliency Total Acres	4,827
Low Resiliency	2,494
Low Resiliency Total Acres	2,494
Moderate Resiliency	7,950
Moderate Resiliency Total Acres	7,95

Ethno-botanical Report
MILL CREEK
watershed analysis

Prepared by: Lance Holmberg, District Botanist
Barlow Ranger District
Mt. Hood National Forest

MANAGEMENT

Treaty Rights

The 6,500,000 acre range of the Mid Columbia Native Americans, prior to the forming of reservations, included the lands north and east of Mt. Jefferson to the Columbia River. The lands extended north along the crest of the Cascades to Mt. Hood and down across the Hood River Valley to the Columbia River. These traditional use lands (Mill Creek Watershed), exclusive of current reservation boundaries, were ceded to the U.S. Government in the 1855 Treaty With The Tribes Of Middle Oregon. Special rights to fishing, hunting, gathering roots and berries, and pasturing stock "...in unclaimed lands, in common with citizens", are provisions of the treaty. The Confederated Tribes of Warm Springs should be included in the planning process for all USFS projects.

Important Traditional Plants of the Tribes of Warm Springs:

A Warm Springs report titled "The Preservation and Management of Cultural Plants on the Warm Springs Indian Reservation; A Proposal", by botanist R. Helliwell, outlines a strategy for management of cultural plants. In addition to management recommendations the report identifies five root plants that are currently among the most important cultural foods, Camas (*Cammassia quamish*), Bitteroot (*Lewisia rediviva*), Biscuit root (*Lomatium cous*), Canby's desert parsley (*Lomatium canbyi*),& Indian carrot (*Perideridia gairdneri*).

Helliwell's report begins..."Families have long had favorite areas for collecting roots; areas they return to year after year. However the Reservation is too large and varied for any single family or person to be familiar with the entire range of cultural plant populations, therefore, as the plants of a favorite area are depleted the people may not know where to turn. This is the manner in which traditions die." Barlow Ranger District can assist the Confederated Tribes of Warm Springs in maintaining tradition by restoring and enhancing selected areas needed to cultivate viable populations of cultural plants.

At present few plant surveys have been conducted on the Forest Service part of this watershed and consequently we do not know just how many species of plants,used by native Americans, are present or how abundant they are. Additionaly we do not know how heavily the area is ustilized by native Americans in gathering cultural plants

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Ethno-botanical Report
east & middle forks of the hood river watershed analysis

Prepared by: Susan Nugent, District Botanist
Hood River Ranger District
Mt. Hood National Forest
June 30, 1996

This document focuses on historic use of plant species that are found in East Fork (EFWS) and Middle Fork (MFWS) Hood River Watersheds. The attached table emphasizes plants that are noted in references as having current and past use by local Native Americans of the mid-Columbia area and the Confederated Tribes of Warm Springs. Sahaptin (language of the Tribes of Warm Springs) names are given for species of the names were found in references. Occasionally more than one species may have the same native name. For purposes of this document the actual uses of each plant are not discussed.

Many of these species also have current use as "special forest products".

The following are a few management considerations that should be integrated during development of plans for the East Fork and Middle Fork Watersheds.

MANAGEMENT

Treaty Rights

The 6,500,000 acre range of the Mid Columbia Native Americans, prior to the forming of reservations, included the lands north and east of Mt. Jefferson to the Columbia River. The lands extended north along the crest of the Cascades to Mt. Hood and down across the Hood River Valley to the Columbia River. These traditional use lands (including the EFWS and MFWS of the Hood River Watershed), exclusive of current reservation boundaries, were ceded to the U.S. Government in the 1855 Treaty With The Tribes Of Middle Oregon. Special rights to fishing, hunting, gathering roots and berries, and pasturing stock "...in unclaimed lands, in common with citizens", are provisions of the treaty. The Confederated Tribes of Warm Springs should be included in the planning process for all USFS projects.

Restoration Opportunities of Traditional Use Areas

The most prominent cultural plant in both the EFWS and MFWS is huckleberry (Vaccinium spp.) In the EFWS the southeast side of Mt. Hood near Hood River Meadows, Mt. Hood Meadows Permit Area, and Bennett Pass are noted as being traditional huckleberry picking areas. In the MFWS the Red Hill area provides huckleberry picking opportunities. These Huckleberry picking areas could be improved to support traditional levels of gathering. Restoration could be achieved by planting additional huckleberries in accessible areas along roads, trails, and openings; and by burning, cutting back or thinning trees from existing huckleberry patches in Hood River Meadows, Mt. Hood Meadows Permit Area, Bennett Pass, and Red Hill areas. The tribal council should be contacted to extend an invitation to help identify additional areas for huckleberry habitat enhancement in the EFWS and MFWS.

Important Traditional Plants of the Tribes of Warm Springs:

A Warm Springs report titled "The Preservation and Management of Cultural Plants on the Warm Springs Indian Reservation; A Proposal", by botanist R. Helliwell, outlines a strategy for management of cultural plants. In addition to management recommendations the report identifies five root plants that are currently among the most important cultural foods, Camas (*Cammassia quamish*), Bitteroot (Lewisia rediviva), Biscuit root (*Lomatium cous*), Canby's desert parsley (*Lomatium canbyi*), Indian carrot (*Perideridia gairdneri*). Of these species, Indian carrot has been documented most often in the East Fork and Middle Fork Hood River watersheds.

Helliwell's report begins..."Families have long had favorite areas for collecting roots; areas they return to year after year. However the Reservation is to large and varied for any single family or person to be familiar with the entire range of cultural plant populations, therefore, as the plants of a favorite area are depleted the people may not know where to turn. This is the manner in which traditions die." The Hood River Ranger District can assist the Confederated Tribes of Warm Springs in maintaining tradition by restoring and enhancing selected areas needed to cultivate viable populations of cultural plants.

In a 1988 Warm Springs Reservation (WSIR) report there are 56 plant species recognized as important to the tribes. The list of species was compiled under the guidance of the Warm Springs Culture and Heritage Committee. Species from the 1988 Warm Springs list, that can be found in the EFWS and MFWS, are italicized in the attached table of species.

Table of Species

The attached list identifies plants by common, Latin, and Sahaptin names (Warm Springs, Yakima, and Umatilla Native Americans). Uses are divided into three components:

(*) Native American Cultural Foods (Warm Springs, Yakima, Umatilla)
This group includes important root and berry plants, vegetable and flour/grain plants.

(+) Native American Medicinal, Ceremonial, or Traditional Use
Includes species that have non food uses such as basket weaving and dipnet cordage, long house and ceremonial purification, cooking utensil materials, dyes, hair and skin tonics, internal and external medicines, traditional potions and "smokes".

( ) General Historic Use (Edible/Medicinal) and Special Forest Products
This group includes species that have been used historically by pioneers, and presently are considered to be "Special Forest Products" that are collected for private use and commercial purposes.

Italicized Names identify "Important Traditional Plants of the WSIR" (1988 WSIR report).

Common Name	Scientific Name	Warm Springs Sahaptin
TREES		
+Fir, silver	Abies amabilis	patuswai
+Fir, grand	Abies grandis	patuswai
+Fir, subalpine	Abies lasiocarpa	patuswai
+Fir, noble	Abies procera	patuswai
+Alder	Alnus rubra, A. sinuata	psuuni
+Chinquapin/chestnut	Castanopsis crysophylla	
+Hawthorn	***Crataegus douglasii***	***snun-aasu***
+Western larch	Larix occidentalis	xatawas/kimila
+Engelmann spruce	Picea engelmannii	
***Pine, whitebark**	Pinus albicaulis	ninik-aas
+Pine, lodgepole	Pinus contorta v. latifolia	kalam-kalam

*+Pine, ponderosa	Pinus ponderosa	tap'aas
+Douglas fir	Pseudotsuga menziesii	pat'atwi
Pacific yew	Taxus brevifolia	wawanins
+Cedar	Thuja plicata, Chamaecyparis nootkatensis	nank
+Hemlock	Tsuga heterophylla, T. mertensiana	waqutqut-yay
+Quaking aspen	Populus tremuloides	nini
+Black cottonwood	Populus tricocarpa	xpxp
*Garry oak/White oak	Quercus garryana	c'unips
SHRUBS		
+Maple	Acer circinatum, A. glabrum v. douglasii	twanuwaas
+Big leaf maple	Acer macrophyllum	sqims
*Serviceberry	Amalanchier alnifolia	ccaa
+Kinnikinnick	Arctostaphylos uva-ursi, A. Nevadensis	ilik
Oregon-grape	Berberis aquifolium	lkawkaw
	B. nervosa, B. repens	lk'auk'au
+Snowbrush ceanothus	Ceanothus velutinus	wicak
+Rabbitbrush	Chrysothamnus nauseosus, C. viscidiflorus	psxu
+Western pipsissewa	Chimaphila umbellata	tanuxit-pama
+Pacific dogwood	Cornus nutallii	
+"Red willow"/dogwood	Cornus stolonifera	luc'ani, lu'ca-ni
*+Wild hazelnut	Corylus cornuta	kkuus

***+Hawthorne**	Crataegus douglassii	snm-aasu
***+Salal**	Gaultheria shallon	niq'ul
+Ocean spray	Holodiscus discolor	pi wayc-pama
+Juniper	Juniperous occidentalis	puus
+*Black twinberry	Lonicera involucrata	miya waxmi tk-watat
+Fools huckleberry	Menziesia ferruginea	
Devil's Club	Oplopanax horridum	sqapqapnu-waas
+Mock-orange	Philadelphus lewesii	saxi
+Bitter cherry	Prunus emarginata	isnips
***Chokecherry**	***Prunus virginiana***	***tms / tmsas***
+Cascara	Rhamnus purshiana	att'itas
+Sumac	Rhus glabra	tantit
***Currant, gooseberry**	***Ribes aureum,***	***xn***
	R. cereum, R. lacustre, R. sanguineum	***pinus-aas***
+*Rose	***Rosa nutkana, R. gymnocarpa***	***sk'apaswai***
***Thimbleberry**	***Rubus parviflorus***	***atunatuna***
***+Salmonberry**	Rubus spectabilis	
****Blackberry**	***Rubus ursinus, Rubus spp.***	***wisik***
+Willow	***Salix exigua, Salix spp***	***txs***
***Elderberry**	***Sambucus cerulea***	***mt'paas***
***+Sitka Mountain ash**	Sorbus sitchensis	ilbaumax

+Snowberry	Symphoricarpos mollis, S. albus	saxi-waakul
+Spiraea	Spiraea densiflora, Spiraea betulifolia	saxisaxiwaakul
*Black huckleberry	Vaccinium alaskaense	wiwnu
*Dwarf huckleberry	V. caespitosum	wiwluwiwlu
*Mountain huckleberry	V. deliciosum	ililmuk
?Bog blueberry	V. occidentale	
*Blue huckleberry	V. ovalifolium, V. membranaceum	wiwnu
*Cranberry	V. oxycoccos	yuxpas
*Red huckleberry	V. parvifolium	luca-luca, wiwnu
*Grouseberry	V. scoparium	nik'ul
+Highbush cranberry	Viburnum edule	
FORBS		
+Yarrow	Achillea millefolium	wapnwapn
+Vanilla leaf	Achlys triphylla	cltpama
+Maidenhair fern	Adiatum pedatum	
+Horsemint	Agastache urticifolia v. urticifolia	
*Wild onion	Allium acuminatum, Allium spp	samamui
Anemone	Anemone deltoidea, A. oregana	
Pussytoes	Antennaria luzuloides	ik ikawas
+Arnica	Arnica cordifolia, A. latifolia, A. mollis	
+Indian Hemp/dogbane	Apocynum sibiricum, A. androsaemifolium	txws

Wild ginger	Asarum caudatum	
Balsamroot sunflower	***Balsamorhiza careyana, B. sagitatta***	***pusxas***
"Buttons"	***Brodiaea hyacinthina, B. howellii***	***st'xws***
Cat's ears	***Calochortus macrocarpus, C. subalpinus***	***nunas***
+Scarlet paintbrush	Castilleja miniata, C. parviflora	nawinala
+Cohosh	Cimicifuga laciniata	
Thistle	all Circium species	qut-qut
Indian potato	Claytonia lanceolata	anipas
+Clematis	Clematis ligusticifolia	tamqikskula
Queencup/Beadlily	Clintonia uniflora	
Goldenthread	Coptis laciniata	
+Bunchberry dogwood	Cornus canadensis	
Bleeding heart	Dicentra formosa	
Foxglove	Digitalis purpurea	
+Woodfern	Dryopteris austriaca	
Fireweed	Epilobium angustifolium	
+Horsetail	Equisetum spp	siik-siik
Stork's bill	Erodium cicutarium	
Avalanche/Fawn lily	Erythronium grandiflorum, E. montanum, E. oregonum	
Wild strawberry	***Fragaria vesca v. bracteata, F. virginiana v. platypetela***	***suspan***

Yellowbell/Choc. lily	***Fritillaria pudica, F. lanceolata***	***skni***
Bedstraw	Galium triflorum, Gallium spp	tisxpanu, lusta lusta
Old man's whiskers	Geum triflorum	suspan-waakut
+Gum plant	Grindelia spp	
***Cow's parsnip**	Heracleum lanatum	txu
Hawkweed	Hieracium albiflorum, H. albertinum	
St. Johnswort	Hypericum perforatum	
+Oregon Iris	Iris tenax	
***Lovage**	Ligusticum canbyi, L. grayi	ayun
***Tiger lily**	Lilium columbianum	paanat
+Skunk cabbage	***Lysichitum americanum***	***watiptip***
***Indian celery & roots**	Lomatium canbyi	luks
	L. dissectum	caluks
	L. grayi (L. suskdorfii)	ayun/latitlatit
	L. macrocarpum	pula
	L. nudicaule	xamsi
	L. piperi	mamn
	L. triternatum (formerly used as food)	
+Tallcup lupine	Lupinus caudatus	wapiuata
+Wild mint	***Mentha arvensis***	***suxwasuxwa***
***False dandelion**	Microseris troximoides	micuna

+Mountain monardella	*Monardella odoratissima*	*waas*
***+Miner's lettuce**	Montia perfoliata, M. parvifolia, M. siberica	
***Yellow pond lily**	Nuphar polysepalum	kalamat
Oregon oxalis	Oxalis oregana	
+Penstemon	Penstemon humilis, P. euglaucas	
***Indian carrot/yampah**	*Perideridia gairdneri*	*sawitk*
+Spreading phlox	Phlox diffusa	mccpla
Plantain	Plantago major	
***Knotweed**	Polygonum bistortoides	kusi-kusi
Self Heal	Prunella vulgaris v. vulgaris	
+Bracken fern	Pteridium aquilinum	c'alaca
Yerba buena	Satureja douglassii	
***Stonecrop**	Sedum stenopetalum, S. oregonum	kitu wayxti-la
False Solomon's seal	Smilacina racemosa, S. stellata	
Goldenrod	Solidago canadensis v. salebrosa	
Twisted stalk	Streptopus amplexifolius	
Dandelion	Taraxacum officinale, Taraxacum spp	
Foamflower	Tiarella trifoliata v. unifoliata	
+Salsify	Tragopogon dubius	
+Trillium	Trillium ovatum	saparica
***Cattail**	*Typha latifolia*	*sc'iu*

Nettle	Urtica dioica v. lyallii	ala'ala
+Valerian	Valeriana sitchensis	
+False helibore	Veratrum californicum, V. viride	nuimun
Mullein	Verbascum thapsus	wasikayk-la
Wild violet	Viola glabella, v. orbiculata	
*Mule's ears	Wyethia amplexicaulis	piipii (piipipi)
+Beargrass	Xerophyllum tenax	yai
GRASS/SEDGE/RUSH		
*Bluebunch wheatgrass	Agropyron spicatum	wasku
*Bromes	Bromus carinatus, B. vulgaris	wasku
*Idaho fescue	Festuca idahoensis	wasku
+Sedge	Carex spp	
*Parry's Rush	Juncus parryi	
LICHENS		
*Black tree lichen	Bryoria fremontii	k'unc
+Wolf lichen	Letharia vulpina	tamklmkl
+Lung lichen	Lobaria pulmonaria	

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Appendix E
Threatened, Endangered, Suspected, and Sensitive Plants

R6 Sensitive Plant species report
MILL CREEK

Watershed Analysis

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Attached is a table of R6 Sensitive Plants, and other species of concern, that are known or suspected to occur in the Mill Creek watersheds.

DEFINITIONS AND CRITERIA

The following are acronyms and ranking criteria used in the attached table:

USFS Regional Forester's List of Region 6 Sensitive plants, specific to the Mt. Hood National Forest (1994 list). Includes species on the Oregon Natural Heritage Data Base (ONHDB) list of Rare, Threatened, and Endangered Plants of Oregon .

Oregon Natural Heritage Data Base, December 1995. Although many of the species on the ONHDB list are not included in the Regional Forester's List of Sensitive Plants, the USFS is encouraged to inventory for ONHDB species in order to keep track of population trends and threats to habitat.

List Categories:

1. Taxa that are threatened with extinction or presumed extinct throughout their entire range.
2. Taxa that are threatened with extirpation or presumed extirpated from the state of Oregon.
3. Species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
4. Taxa which are of conservation concern, but are not currently threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered.

LIVERWORTS, MOSSES, LICHENS

Documented (D) and suspected (S) to occur in Mill Creek watershed.

	SPECIES	USFS	ONHDB 95
S	*Ulota megalospora* (added in 1997)		3
S	*Lecanora pringlei*		3

VASCULAR PLANTS

Documented (D) and suspected (S) to occur in Mill Creek watershed.

	SPECIES	USFS	ONHDB 95
S	*Agoseris elata*	R6 Sens.	2
S	*Allium campanulatum*		4
D	*Arabis furcata*		4
D	*Arabis sparsiflora var. atrorubens*	R6 Sens.	2
D	*Astragalus hoodianus*	R6 Sens.	2
S	*Botrychium minganense*	R6 Sens.	2
S	*Botrychium montanum*	R6 Sens.	2
S	*Botrychium pinnatum*	R6 Sens	2
S	*Calochortus longebarbatus var. longebarbatus*	R6 Sens.	1
S	*Chaenactis nevii*		4
S	*Cypripedium montanum*		4
S	*Diphasiastrum complanatum*	R6 Sens.	2
S	*Hackellia diffusa var. cottoni*		4
D	*Lomatium watsonii*	R6 Sens.	2
S	*Lycopodium annotinum*		4
S	*Meconella oregana*	R6 Sens.	1
S	*Penstemon barrettiae*	R6 Sens.	1
D	*Ranunculus reconditus*	R6 Sens.	1
S	*Suskdorfia violacea*	R6 Sens.	2

SUMMARY - R6 Sensitive Plants - Management and Restoration

There are four R6 Sensitive Plants that are have been documented in the Mill Creek watershed: *Arabis sparsiflora* var. *atrorubens* (sickle-pod rockcress), *Ranunculus reconditus* (The Dalles Mt. Buttercup), *Astragalus hoodianus* (Hood River milk-vetch), and *Lomatium watsonii* (Watson's desert-parsley).

Hood River milk-vetch is known from two locations in this watershed, one historical with no location given and the other on private land within the Columbia Gorge National Scenic Area (CGNSA).

Watson's desert-parsley, was found on a BLM parcel on Mill Creek Ridge.

The Dalles Mt. Buttercup grows on Mill Creek Ridge on a parcel owned by The Nature Conservancy and at present does not seem to be threatened. A second population is located on private ground.

Sickle-pod rockcress grows along Surveyor's Ridge. It is the only sensitive plant species within the forest boundary in this watershed. Some of the populations straddle the boundary between the Barlow and Hood River Ranger Districts along surveyors ridge. The following impacts are currently affecting this species:

Impacts and Potential Restoration - Surveyor's Ridge:

Noxious weeds Knapweed is encroaching on habitats in open grassy meadows and gravelly slopes along Surveyor's Ridge.

Recreation There is evidence of off road compaction, soil displacement, and vegetation damage.

Cattle There is evidence of manure concentrations and trampling in sensitive plant habitat along Surveyor's Ridge.

Potential Restoration Handpull weeds in areas of highest concern. Decompact soils in habitat, (ripping roads increased the population of sickle-pod rockcress in an adjacent watershed). Omit habitat areas from open range grazing allotments. Conduct an intensive public awareness campaign by providing educational material at the trailhead that discusses the above problems, potential solutions, and pertinent restoration projects in the area.

Details for restoration will be developed on a site-specific basis and should be coordinated at an interdisciplinary level. Input from a range specialist.

Sensitve species.

Arabis sparsiflora var. *atrorubens* : Sicklepod rockcress is uncommon but is found on both Barlow and Hood River districts, on dry , rocky openings on ridgetops and slopes in pine/oak/Douglas-fir stands at 2,800 to 4,200 ft. elevation. It seems to be more common near brush probably because it is somewhat protected from grazing by large herbivores since it also does well in more open situations if not grazed. All populations are on the north end of the districts with the majority of the populations found in Mill Creek, Fivemile and East Fork Hood River watersheds, especially along Mill Creek Ridge and Surveyors Ridge. It is a Region 6 sensitve species and Oregon Heritage Program list 2 (rare in the state but more common elsewhere). Current conditions seem good but there is some threat from habitat invasion by knapweed and cheatgrass. Along Surveyor's Ridge off road vehicles use has created some tracks that have reduced habitat. Early grazing ,prior to seed dispersal, will reduce seeding and new plant recruitment (it is a biennial or weak perinnial so it must continue to produce new plants to maintain its existence) There is some cattle grazing in the area. Road obliteration and ripping increased the number of plants in the Fivemile Watreshed. Apparently some disturbance helps maintain or increase the plant population. Road ripping and fire would likely benefit the population. The first observation listed for this plant in the Oregon Heritage Program database for this area is 1982 so there is no record of historical abundance.

Astragalus hoodianus : Hoodriver milk-vetch is an uncommon endemic found only in Oregon and Washington near the Coumbia River Gorge near The Dalles, Lyle and Mosier. Lower Mill Creek seems to be about the center of the range. All of the known sites are off the forest at lower elevations. The Oregon Natural Heritage Program lists it as secure and not rare throughout its range but rare, threatened or uncommon in Oregon. The most likely threats are grazing, farming and development. The plant is a palatable periennial that can withstand some grazing if allowed to set and disperse seed. The earliest reported sightings are circa 1917 and some sites have not been relocated. The total population has certainly been reduced from historic levels since much of its range is in areas suitable for farms, orchards, and both urban and rural development.

Lomatium watsonii : Watson's desert parsley is considered globally secure but rare within the state. Two small populations were found recently on Mill Creek ridge on BLM land near the forest boundary. It is some what threatened by off road motor vehicles using the open grassy areas that are its habitat. If the road access remains in poor condition or is closed these populations will probably remain stable but if off road use increases, particularly early in the season, there will likely be a decline. Since the sites were recently discovered there is no sound basis to determine historical abundance however the sites have not had much disturbance and are rather remote so it is likely the population is about as abundant as it ever was in this local.

Ranunculus reconditus : The Dalles Mtn. buttercup is listed as a G-2 (rare through out its range) and critically imperiled in Oregon. It is listed as list 1 (endangered or threatened throughout its range) in the Oregon Natural Heritage Program and listed endangered by the state of Oregon. The Oregon Natural Heritage Program lists 3 sites in Oregon, two are still existing. Both are in the North Fork Mill Creek subwatershed, one in the Mill Creek Preserve on Mill Creek ridge and the other is on private land. The Mill Creek ridge site was visited in the spring of 1997 and was in good condition with no obvious threats. Both existing sites are associated with basalt rock outcrops in grassy dry sites. The first site reported in

Oregon was last seen in 1895 and is just outside of this watershed. The sites in this watershed were first reported in 1985 and 1987 so there is no historical record for this area. It is likely that the species is less abundant now since it occurs where grazing was common.

Survey and manage species from the Record of Decision for the Northwest Forest Plan.

There are no known vascular plants, fungi or bryophytes with managment implications from the Record of Decision known to occur in the Mill Creek Watershed at present. There are several species that could potentially be found here. A list of those species that may be found in this watershed and which have managment implications (strategies 1 or 2) are found in (appendix E)

There are four components or strategies for the species as listed in table C-3 of the ROD.

- *Survey Strategy 1 - Manage known sites* : This may mean complete protection or simply considering the species when planning actions, based on current information. There is still some question as to whether these species have to be dealt with if they are discovered after an activity is initiated such as the TE&S species are. Current advise is that there will be direction to manage sites as soon as they become known even after an activity is initiated. Management guides are being developed by the Regional Ecosystem Office but as of April 1997 only the draft management guide for bryophytes has been distributed.

- *Survey Strategy 2 - Survey prior to ground disturbing activities.* The Regional ecosystem office is responsible to develop protocols for conducting these surveys which must be completed prior to ground disturbing activities implemented in F.Y. 99 or later. We have very minimal information on most of these species. The REO is currently compiling information and developing survey protocols but as of April 1997 none have been distributed. The district botanists can identify and survey for the vascular plants on the list however the bryopytes, lichens, and fungi usually require more specialized knowledge than is typically available on the district or even forest level. Currently the responsibility to conduct these surveys has been assumed by the region and forest. Fortunately this forest does have the expertise to identify the few species in this category that might be found in the Mill Creek watershed, based on the habitats where these species have been found.

- *Survey Strategy 3 - Extensive surveys* : Conduct extensive surveys for the species to find high-priority sites for species management. Surveys **are not** required prior to conducting ground disturbing activities. Responsiblility for these surveys is at the regional and forest level. The ROD states that these surveys are to be underway by 1996 but no survey protocls have been distributed as yet and no formal surveys have been conducted in this area. The important point here is that these surveys are not required before any activities, however many of these are strategy 1 species which, if found, must be managed.

Survey Strategy 4 - General regional surveys : Survey for species to acquire additional information and to determine necessary levels of protection. . Currently the responsibility to conduct these surveys has been assumed by the region. They are to be initiated by FY 1996 and be done in 10 years, but no survey protocls have been distributed as yet and no surveys have been conducted in this area.

Survey strategy 2 species suspected to occur in the Mill Creek Watershed.

Species	Growth form	Strategy
Oxyporus nobilissimus	fungus, polypore	1, 2, 3
Bondarzewia montana	fungus, polypore	1, 2, 3
Hypogymnia duplicata	lichen	1, 2, 3
Tritomaria expectiformis	liverwort	1, 2
Ulota megalospora	moss	1, 2
Allotropa virgata	candystick, vascular plant	1, 2
Botrychium minganense	gray moonwort, grape-fern	1,2 & R6 sensitive
Botrychium montanum	moutain grape-fern	1,2 & R6 sensitive

Appendix F
Survey and Manage Plants

Survey & Manage Plant Report
Mill Creek Watershed Analysis

Prepared by: Lance Holmberg, District Botanist
Barlow Ranger District
Mt. Hood National Forest
June 10, 1996

BACKGROUND INFORMATION, DEFINITIONS, STANDARDS AND GUIDELINES

The 1994 Record of Decision (ROD)/Standards and Guidelines for Management of Habitat...Within the Range of the Northern Spotted Owl identifies fungal, lichen and plant species (see ROD Table C3 pp C 49 through C 61) to be protected through survey and management standards and guidelines. The measures apply to all land allocations (ROD C 4, paragraph 4).

The term "Survey and Manage" refers to species that are listed in the FSEIS Appendix J2, and ROD Table C3. Survey and Manage species include rare, locally endemic, and "at risk" species that are associated with late successional and old Growth forests within the range of the Northern Spotted Owl.

Standards and guidelines on pages C 4 through C 6 of the ROD describe four components (or strategies) to be applied to species identified in Table C3, and the implementation schedule for each component. The first and highest priority is "Manage Known Sites" (Survey Strategy 1). Survey strategy 2, and some of the strategy 3 species include direction to "Manage Sites". Activities that are scheduled for implementation in 1995 and later must include management provisions for known sites (ROD C 4, paragraph 5).

Surveys for component 2 species **must precede** the design of all ground-disturbing activities implemented in 1999 or later. (This includes most of the protection buffer species listed on pages C-20 and C-27 of the ROD). In Region 6, implementation has been interpreted to commence when a decision document is signed. Surveys for component 3 species (extensive surveys to find high priority sites for species management) are to be underway by 1996 but **are not** required prior to ground-disturbing activities. Component 4 surveys (general regional surveys) are to acquire additional information and to determine necessary levels of protection. They are to be initiated no later than F.Y. 1996. There is no mention of surveys prior to ground disturbing activities.

Management guides and survey protocols are still being developed and the species listed under the various component strategies is expected to change.

SUMMARY

Species Suspected to Occur in Mill Creek Watershed

The attached table at the end of this report lists Survey and Manage fungi, lichens, mosses, liverworts, and vascular plants that might occur in the Mill Creek watershed. The list also includes a brief description of habitat and range/distribution of each species; more detailed information for each species can be found in FEIS Appendix J2 pages 83 292. Only species which include strategies 1 or 2 have been included as they are the only ones that have management implications at present. There are a large number of strategy 3 species listed because they are also listed as strategy 1

INSUFFICIENT INFORMATION

Several knowledgeable specialists in the scientific community were consulted during research for this document (see References). Without exception these individuals stressed that the information currently available on habitat types, distribution range, geographic extent, and ecology of fungi, lichens, and bryophytes (mosses and liverworts), is not at all conclusive. There is a paucity of information available for these groups, due in part to the lack of actual field surveys and expertise. Therefore the data in this report should only be used as a preliminary analysis of base information to be expanded upon prior to actual field verification surveys.

The information in this document should not be used **exclusively** to determine whether or not a species has potential to occur in the Mill Creek Watershed, or on the Mt. Hood National Forest.
/s/ L.Holmberg
District Botanist

SURVEY AND MANAGE SPECIES SUSPECTED TO OCCUR IN THE EAST FORK (EFWS) AND MIDDLE FORK (MFWS) OF THE HOOD RIVER WATERSHED

CODES USED IN THE ATTACHED TABLE

The attached table format is similar to the ROD Table C 3 on pages 49 to 61, with fungi groups listed first, lichen groups second, bryophytes third, and vascular plants last. Additional columns were added to incorporate habitat information and known range and/or geographic extent. Appendix J2, pages 83 247, provided a large percent of the information available regarding species range and geographic extent. The following key identifies codes used to expedite and condense this document.

Survey Strategies: 1 = Manage Known Sites; 2 = Survey Prior to Activities and Manage Sites; 3 = Conduct Extensive Surveys and Manage Sites;

Occurrence
S Suspected to occur, habitat present
? Unknown, inadequate info.
X = Added after Appendix J2
MHNF Mt. Hood National Forest

SURVEY AND MANAGE SPECIES SUSPECTED TO OCCUR IN THE EAST FORK (EFWS) AND MIDDLE FORK (MFWS) OF THE HOOD RIVER WATERSHED

Species	Survey Stratagies	Mill Cr.	Habitat	Known Geogr. Range or Extent
FUNGI				
MYCORRHIZAL FUNGI				
BOLETES				
Gastroboletus subalpinus	1, 3	S	above 4500', ecto-michorrizal w/pines	Endemic Ore. Casc. & N. Sierras
RARE BOLETES				
Boletus haematinus	1, 3	S	high elev silver fir	Cal. north to Wash
Boletus pulcherrimus	1, 3	S	low-mid elev conifer	Cal. to Canada, north to Olympics
Gastroboletus imbellus	1,3 1, 3	S S	upper mid elev (5000') w/ABAM, ABGR, PSME, TSHE, TSME, possibly ectomycorrhizal w/pine	locally endemic to Willamette NF(WNF) Ollalie Trail & Lamb Butte Scenic
Gastroboletus rubra	1, 3	S	upper mid-high elev. w/mature TSME and developed humus layer.	endemic to WA N. Casc. south to Willamette Pass OR
FALSE TRUFFLES				
Nivatogastrium nubigenium	1, 3	S	mid-high elev. in mature forests w/abundant lg. coarse woody (relies on mammals for dispersal)	Casc. Mts. of CA, N. to Mt. Adams, & north ID.

RARE FALSE TRUFFLES				
Alpova alexsmithii	1, 3	S	mid to upper mid elev. w/true firs, TSHE, and possibly pines.	endemic to Casc. Mts. & British Columbia Coast Rng
Arcangeliella crassa *A. lactarioides*	1, 3 1, 3	? ?	mid to high elev. montane forests w/ Abies spp. and /or TSME.	Western OR, N. CA Mts. Shasta/Lassen.
Destuntzia fusca *D. rubra*	1, 3 1, 3	S S	low to lower-mid elev. in variously mixed true firs, TSHE, PSME, oaks, pines, redwood	Mendocino Cnty. CA & Willamette N.F. (WNF), Linn Cnty.
Gautieria magnicellaris	1, 3	S	high elev. w/TSME and true firs	WNF, Klamath NF, Mt. Wash. Wildns., NE USA, Germany, Czechoslovakia
Gautieria otthii	1, 3	S	mid to upper-mid elev. ectomychorrizal w/ Pinaceae	N. CA, Sisk. Mts, OR Centr. Cascades Europe, Alaska
Macowanites mollis	1, 3	S	mid elev. mature to old-growth PSME, Pines	Mt. Rainier NP, Larch Mt., MHNF
Martellia fragrans	1, 3	S	mid-high elev. old-growth TSME/Abies spp	S. OR, N. CA, & ID
Martellia idahoensis	1, 3	S	mid-upper mid elev. w/ true firs & Pinacea	Coast Range SNF, Cascade Range, WNF N. ID
Martellia monticola	1, 3	S	mid-high elev. old-growth TSME/Abies spp.	Central to North Oregon Cascades
Rhizopogon brunneiniger	1, 3	S	low-high elev. dry old growth PSME/TSME/fir/ pine forest	N. OR Cascades & coast ranges, & N. CA
Rhizopogon evadens var. subalpinus	1, 3	S	upper mid elev. TSME/ fir/pine forest near timberline	N. CA to WA & ID
Rhizopogon exiguus	1, 3	S	moist-dry mature to old-growth PSME/TSME low-mid elev. forest	Cascade Mt., WA & coast ranges of Or
Rhizopogon flavofibrillosus	1, 3	S	mid-upper mid elev. mature to old-growth mixed conifer forest	N. CA, Siskiyou Mts, & central Cascades of OR
Rhizopogon inquinatus	1, 3	S	mid upper mid elev. mature to old-growth PSME forest	S. Santiam River, WNF, & ID

Sedecula pulvinata	1, 3	?	mid-high elev. old-growth TSME/Abies spp.	Mt. Shasta to Yuba Pass, CA & CO
UNDESCRIBED TAXA, RARE TRUFFLES & FALSE TRUFFLES				
Gymnomyces sp. nov. #Trappe 5052	1, 3	S	high elev. mature to old-growth TSME/ABAM forest	Phlox Pt., Mt.Hood NF, OR
Gymnomyces sp. nov. #Trappe 1690 & #1706, 1710	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABPR/ABAM/TSME forest	W. OR Cascades, Willamette NF (WNF)
Hydnotrya sp. nov. #Trappe 787, 792	1, 3	S	upper mid elev. old-growth ABAM/TSME forest	Mt. Jefferson, WNF
Hydnotrya subnix sp. nov. #Trappe 1861	1, 3	S	old-growth ABAM forest	Gifford Pinchot NF WA
Martellia sp. nov. #Trappe 311, 649	1, 3	S	high elev. mature to old-growth TSME/ABAM forest	Phlox Pt., Mt.Hood NF, OR
Martellia sp. nov. #Trappe 1700	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/TSME forest	Willamette NF, OR
Martellia sp. nov. #Trappe 5903	1, 3	S	upper mid elev. old-growth ABAM/TSME forest	Mt. Jefferson, WNF
Octavianina sp. nov. #Trappe 7502	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/TSME forest	Willamette NF, OR
Rhizopogon sp. nov. #Trappe 1692, 1698	1, 3	S	upper mid elev. mature to old-growth ABGR/ ABAM/PSME/TSME forest	Willamette NF, OR
RARE TRUFFLES				
Choiromyces alveolatus	1, 3	S	mid-high elev. old-growth TSME/Abies spp. forest	Mt. Hood, OR to Yuba Pass, CA
Choiromyces venosus	1, 3	S	low elev. w/coniferous deciduous or mature PSME forest	Springfield, OR & Europe

Elaphomyces anthracinus	1, 3	S	mature PIPO forest	W. Europe, E. North America, & E. OR Cascades
Elaphomycep subviscidus	1, 3	?	mid elev. mature to old-growth pine forest	Central to S. OR Cascades
RARE CHANTERELLE				
Cantharellus formosus	1, 3	S	coniferous & mixed forest	N. CA, OR, & WA
Polyozellus multiplex	1, 3	S	intermittent streams montane fir forest	N Sierras, CA & Cascades, OR & WA
UNCOMMON & RARE CORAL FUNGI (App. J2, pp 163, 164)				
(*Ramaria* spp.)	(1,3) & (3)	S	w/TSHE, Abies, Picea, Pinup, Pseudotsuga, & Taxus	N. CA, OR, WA Overall distribution of individual spp., unknown.
PHAEOCOLLYBIA (App. J2, p. 166)				
(*Phaeocollybia* spp)	(1,3)	S	low elev. to montane, w/conifers, moist hab. (prefers low elev.)	Distribution and frequency currently under study.
RARE GILLED MUSHROOMS				
Chroogomphus loculatus	1, 3	S	upper mid-elev (5000') w/ABAM, ABGR, PSME, TSHE, TSME.	local endemic, type locality Ollalie Trail, WNF
Corfinarius canabarba *C. variipes* *Tricholoma venenatum*	1, 3 1, 3 1, 3 1, 3	S S S	The range of elev. and host species are unknown. All require diverse coniferous forests w/heavy hummus layer and crs. woody.	Overall ecology and distribution are not well known for these species.
Cortinarius verrucisporus	1, 3	S	high elev. montane, w/ conifers & true firs, hypogeous (fruits underground)	CA and OR
Cortinarius wiebeae	1, 3	?	(same as above)	Local endemic/MHNF only known site
RARE ECTO-POLYPORES				
Albatrellus avellaneus	1, 3	? ?	coastal old-growth & mixed hardwood forest	WA, OR, N. CA, Rocky Mts., NE. US & Europe
RARE GILLED MUSHROOMS				

Rhodocybe nitida	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	WA, OR, & CA
Rhodocybe speciosa	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	Mt. Rainier Natl. Park to Barlow Pass
Tricholomopsis fulvescens	1, 3	S	low-mid elev. moist late successional forest, large logs in later stages of decay	Mt. Hood area, Mt. Rainier Natl. park Mt. Baker-Snoq. NF
NOBLE POLYPORE (Rare and Endangered)				
Oxyporus nobilissimus	1, 2, 3	S	late-successional forest on Abies spp. esp. A. procera	OR & WA Cascades
BONDARZEWIA POLYPORE				
Bondarzewia montana	1, 2, 3	S	late-successional high elev. forest on associate w/Abies	Pacific Northwest, W. NV, & ID
RARE RESUPINATES AND POLYPORES				
Aleurodiscus farlowii	1, 3	S	on wood, humus, litter stumps, & dead roots	WA, OR, & N. CA
Dichostereum granulosum	1, 3	S	(same as above)	(same as above)
RARE CUP FUNGI				
+Aleuria rhenana	1, 3	S	late successional conifer forest liter	San Francisco to Mt. Rainier
Gelatinodiscus flavidus	1, 3	S	needles, cones, & twig of high elev. Alaska Yellow cedar	BC, Olympic Penn., OR & WA Cascades, & Central OR
Helvella compressa *H. crassitunicata* *H. elastica* *H. maculata*	1, 3	S S S S	low-mid elev. riparian & wet late succession forest	temperate forested area of N. America
Neournula pouchetii	1, 3	S	late-successional Thuja and Tsuga forest	N. OR & WA
Pithya vulgaris	1, 3	S	high elev. Abies forest	BC, WA, ID, & OR
Plectania latahensis	1, 3	S	upper montane, subalpine conifer forest	OR, WA, ID, & BC
Plectania milleri	1, 3	S	montane, subalpine conifer forest	OR, WA, ID, & BC
LICHENS				
RARE FORAGE LICHENS				

Bryoria tortuosa	1, 3	S	low-mid elev, coastal on conifers, inland in pine/oak.	Central Cal. to Brit. Col., Cascades
RARE LEAFY LICHENS				
Hypogymnia duplicata	1, 2, 3	?	low elev wet, foggy, windy coast & maritime sites on conifers	Ore. to Alaska
Tholurna dissimilis	1, 3	S	subalpine fog zone on stunted TSME, canopy of old-growth PSME	Montane areas of Ore. & Wash.
RARE NITROGEN FIXING LICHENS				
Lobaria linita	1, 3	S	old-growth PSME & moist fir forest	N. Ore. to southeast Alaska, Idaho
Pannaria rubiginosa	1, 3	S	bases of trees in mature forest	Salem, Ore. & Mt. Rainier, Wash.
Pseudocyphellaria rainierensis	1, 3	S	old-growth forest on trunks of PSME	Cascades of Wash. and Ore.
RARE ROCK LICHENS				
Pilophorus nigricaulis	1, 3	S	talus rock patches w/in old-growth forest w/ low fire frequency	coastal Ore., Wash. & Brit. Col.
AQUATIC LICHENS				
Dermatocarpon luridum	1, 3	S	low-mid elev. streams	Ore., Brit. Col., Colo., & Virginia
Hydrothyria venosa	1, 3	S	mid-high elev. clear, cold streams in pristine old-growth	Central Cal. to central Brit. Col.
Leptogium rivale	1, 3	S	low-mid elev. streams	Oregon & Montana
ADDITIONAL LICHENS (Added after Appendix J2)				
Cladonia norvegica	1, 3	?	unknown (inadequate info.)	unknown
BRYOPHYTES				
Marsupella emarginata var. *aquatica*	1, 2	S	mid-high elev. stream splash zones	Oregon Cascades
Plagiochila satol X	1, 3	S	old-growth forest on cliffs, rocks, & bark	Pacific Northwest
Racomitrium aquaticum X	1, 3	S	shaded moist rocks & streambanks of old-growth forest	unknown
Tritomaria expectiformis	1, 2	S	old-growth forest on moist shaded rocks	Ore. & Wash. old-growth
Ulota megalospora	1,2	S	older stands of *Abies* and on alder.	CA, WA
VASCULAR PLANTS				

Allotropa virgata	1,2	S	1500'-5000' elev. under closed canopy ABAM, ABGR, PICO, PSME requires association w/fungus & vasc. plants(saprophytic)	east slopes Casc. range to coast, BC to CA, disjunct in ID & MO.
Botrychium minganense	1, 2	S	variable elev. w/THPL and/or ACCI, ACMA variable moist habs.	Endemic to North America, difficult taxonomically
Botrychium montanum	1, 2	S	between 3200' & 4100' (MHNF) in deep shade old-growth THPL, seeps	Endemic to western North America

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Appendix G
Noxious Weeds

Noxious Weeds

The following weeds are present or suspected in the Mill Creek Watershed and are on the Oregon State list of noxious weeds. They are all on the B list (a weed of economic importance which is regionally abundant, but which may have limited distribution in some counties.) Some are "T" designated weeds which are target noxious weeds, on which the Oregon Department of Agriculture will implement a statewide management plan. Weeds with an * have biological control agents available.

***Bull thistle**. Suspected, probably occasional, not managed.

***Canada Thistle**. Present in some clearcuts but not managed and tends to diminish as the stand recovers.

***Diffuse knapweed**. (include here spotted and meadow knapweeds) Present along road sides, disturbed areas, and openings on ridges especially where gophers turn up bare soil. It is competing with the sensitive plants, sickle-pod rockcress, and perhaps Watson's desert-parsley. This species is so widespread and difficult to control that apart from specific sensitive areas there is no control effort. The biocontrol agent is not very effective. Spotted and meadow knapweed are not as common and should be controled if the populations are small enough to be economicaly treated. Hand pulling is not usually very effective. These plants also have some alleopathic activity and readily displace native forbs and grasses.

Houndstongue. This is not known in the watershed but if found should be immediately eradicated using every available method as it has the potential to spread rapidly into disturbed sites. The seeds are covered with fine velcro like hooks that will cling to the fur of any animal or to most clothing. As a result it can be transported long distances to remote sites. This weed is an enormous problem south of the White River in habitat similar to this watershed.

Quackgrass. Suspected but of little conern in this area.

***Rush skeleton weed**. "T" Suspected on the forest and present near the Columbia River Gorge where it is actively being controlled by Wasco County. This weed should be eradicated wherever found because once established it is difficlt to eradicate and can infest large areas and spread to agriclutual lands.

***Scotchbroom**. Suspected. This is very likely to be present but probaly in small patches. It usually controlable in this type of habitat by handpulling or in the case of larger plants lopping of at ground level. While it does not spread rapidly here it should be eradicated as soon as detected.

St. Johnswort. Suspected and likely present but not subject to control. In habitat similar to this it is mostly an occasional weed that is having little impact.

***Tansy ragwort**. "T" May be present. Wasco and Hood River County have an active control program for this species which the forest supports and funds through the state of Oregon. The county surveys for this and handpulls known sites. It is not a problem in terms of forest managment but it is toxic when consumed by cattle and is a serious problem in cultivated pastures. The major concern is that the forest does not develop a population that can spread to private holdings.

***Yellow starthistle**. "T" Was recently detected in East Fork of the Hood River. If found it should be eradicated as quickly as possible.

Many of these weeds are found along road sides and can be spread by vehicles, especially knapweeds which often lodge under a vehicle. The disturbed road shoulders are commonly dominated by invasive weeds that can then spread into the surrounding environment. Closing roads can reduce the spread of weeds by motor vehicles however there is a trade-off. Much of the monitoring and many incidental discoveries of new populations are dependent on easy access. Control efforts are usually much more difficult and expensive when there is no road access.

EAST & MIDDLE FORKS OF THE HOOD RIVER WATERSHED ANALYSIS

Prepared by: Heather Laub, Botanist
Hood River Ranger District
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May 20, 1996

Of the four issues identified, noxious weeds predominantly relate to the one dealing with the quantity and distribution of late-seral habitat and its affected dependent species. Native plant communities in the East and Middle Forks of the Hood River watersheds are in jeopardy from the invasion and expansion of noxious weed populations. Of the state list of noxious weeds, these watersheds contain 12 designated weeds (Noxious Weed Policy and Classification System, 1995).

Common Name	Scientific Name
Bull Thistle	Cirsium vulgare
Canada Thistle	Cirsium arvense
Diffuse knapweed	Centaurea diffusa
Meadow knapweed	Centaurea pratensis
Scotch broom	Cytisus scoparius
Spotted knapweed	Centaurea maculosa
St. Johnswort	Hypericum perforatum
Tansy ragwort	Senecio jacobaea
Yellow starthistle	Centaurea solstitialis
Yellow toadflax	Linaria vulgaris
Purple loosestrife	Lythrum salicaria
Houndstongue	Cynoglossum officinale

These weeds have been found along all of the major roadways and are present in most of the timber sale units harvested within the last 20 years (Noxious Weed Survey and Inventory, 1993). Currently, the invasion rate of noxious weeds is greater than control efforts mainly due to insufficient funding at both the state and federal levels.

Noxious weeds can reduce plant community's capability to produce forest products such as herbs, mushrooms, and wood by outcompeting the native plants. These weeds have been proven to hoard nutrients and moisture, secrete allelopathic substances, produce vast amounts of seeds, spread vegetatively, and create generally unfavorable conditions for the growth of other plants. Some plants not classified as "noxious" weeds also warrant control due to their aggressive growth in sensitive areas such as Bird's foot trefoil (*Lotus corniculatus*) in the Mount Hood and Hood River Meadows area.

A priority for control in the East Fork watershed are the populations of Spotted and Diffuse knapweeds (*Centaurea maculosa and C. diffusa*) on Surveyor's ridge which are degrading habitat for the sensitive plants *Arabis sparsiflora* var. *atrorubens* and *Lomatium watsonii*. High recreation volume tends to continue the spread of these weeds along the roads and trails. The powerlines near Bald Butte also provide a corridor for the spread of noxious weeds. Herbicides have been used in the powerline corridor in the past and the effects on the noxious weed populations and on the nearby sensitive plants are unstudied.

The forest noxious weed program is an integrated approach using a variety of control techniques that include biological, manual, mechanical, prescribed fire, and cultural treatments. Currently, biological control agents have been released for Tansy ragwort (*Senecio jacobaea*), Scotch broom (*Cytisus scoparius*), Spotted knapweed (*Centaurea maculosa*), and St. Johnswort (*Hypericum perforatum*). The Hood River Ranger District has contracted Hood River County to do annual inventories, and manual and mechanical control of their noxious weeds. By regulation, herbicides are used only when other methods are ineffective because of their possible negative impacts to human health and to forest ecosystem balance. Highway 35, FS roads 1700 and 4400, and

Horsethief Meadows have been selected for herbicide application and are being included in an amendment to the Environmental Assessment for the Management of Noxious Weeds for the Mount Hood National Forest.

Sources of continuing infestation include rock quarries, trails open to horse use, and uncertified seed and straw used for erosion control. Transportation of rock from a weed infested quarry can spread a weed problem into newly disturbed sites such as landings and roads. Eradication of noxious weeds in rock quarries leads to prevention which is the most effective means of control. The feed and manure of horses can carry noxious weed seeds along trail systems and into remote areas where control may be difficult. New noxious weed populations include Houndstongue (*Cynoglossum officinale*) and Yellow starthistle (*Centaurea solstitialis*) which were found for the first time last year on forest land in the East Fork watershed and they pose an immediate threat of spread into the watersheds if not taken care of promptly (Work Report for Hood River County Weed and Pest Control, 1995).

The presence of noxious weeds can also be tied into the issue of declining fish populations in the watersheds via their negative impacts on riparian areas. Bull thistle (*Cirsium vulgare*) and Purple loosestrife (*Lythrum salicaria*) are species which thrive in riparian habitats and have the ability to choke out native plants, fish, and wildlife species. They can be spread by any recreation activity which takes a person from one stream to another such as fishing. Currently, there are no documented sites of Purple loosestrife (*Lythrum salicaria*) on National Forest System Lands, however, it is present in Trout Creek just outside the forest boundary. It has also been found in Neal Creek (Mainstem Hood River Watershed), and along the East Fork Irrigation District Canal. Control of these species poses a problem due to the sensitivity of riparian areas to herbicides.

REFERENCES

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Survey and Inventory of Noxious Weeds on Mount Hood National Forest conducted by Jerry Igo. 1993.

Work Reports for Hood River County Weed and Pest Control. 1993-1995.

Environmental Assessment for the Management of Noxious Weeds. Mount Hood National Forest. 1994.

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Appendix H
Range

Current Range Allotment Management Direction/Strategies

The summary below is intended to inform the Mill Creek Watershed Analysis Team of the current situation (within the last eight years) of the grazing allotment management direction/strategies and stocking levels. There is a small portion of one allotment, (Long Prairie) that would be within the Mill Creek Watershed Analysis Boundary.

Since implementation of the Mt. Hood National Forest Land and Resource Management Plan (1990), 3 Short Term monitoring sites (Utilization Studies) were established within this area of this allotment. There have been some Long Term monitoring sites (Condition/Trend) that have been established, along Mill Creek ridge, some dating back to the late 1950's. Before livestock are turned out onto a specific allotment, a third type of monitoring occurs, and that is called "Range Readiness". Basically, the methodology involves ocular estimation of two things, 1) key plant species development, ie. a particular grass species must have at least its current year seed heads exposed, and out of the "boot stage", 2) the soils need to be dry and firm enough to carry stock without breaking the sod or destroyong the cover.

Since 1990 stocking levels have dropped within this allotment and one of two permittees has taken Non-use in 4 out of the last 8 years. There was also a land exchange that removed approximately over 1200 acres from the overall land base. This in turn resulted in issuance of a Term Private Land Grazing Permit being issued for these permittees.

TOTAL NUMBERS BEFORE LAND EXCHANGE

	1990	1991	1992	1993
Long Prairie	125	125	125	125

TOTAL NUMBERS AFTER LAND EXCHANGE

	1994	1995	1996	1997
Long Prairie	105	52	52	52

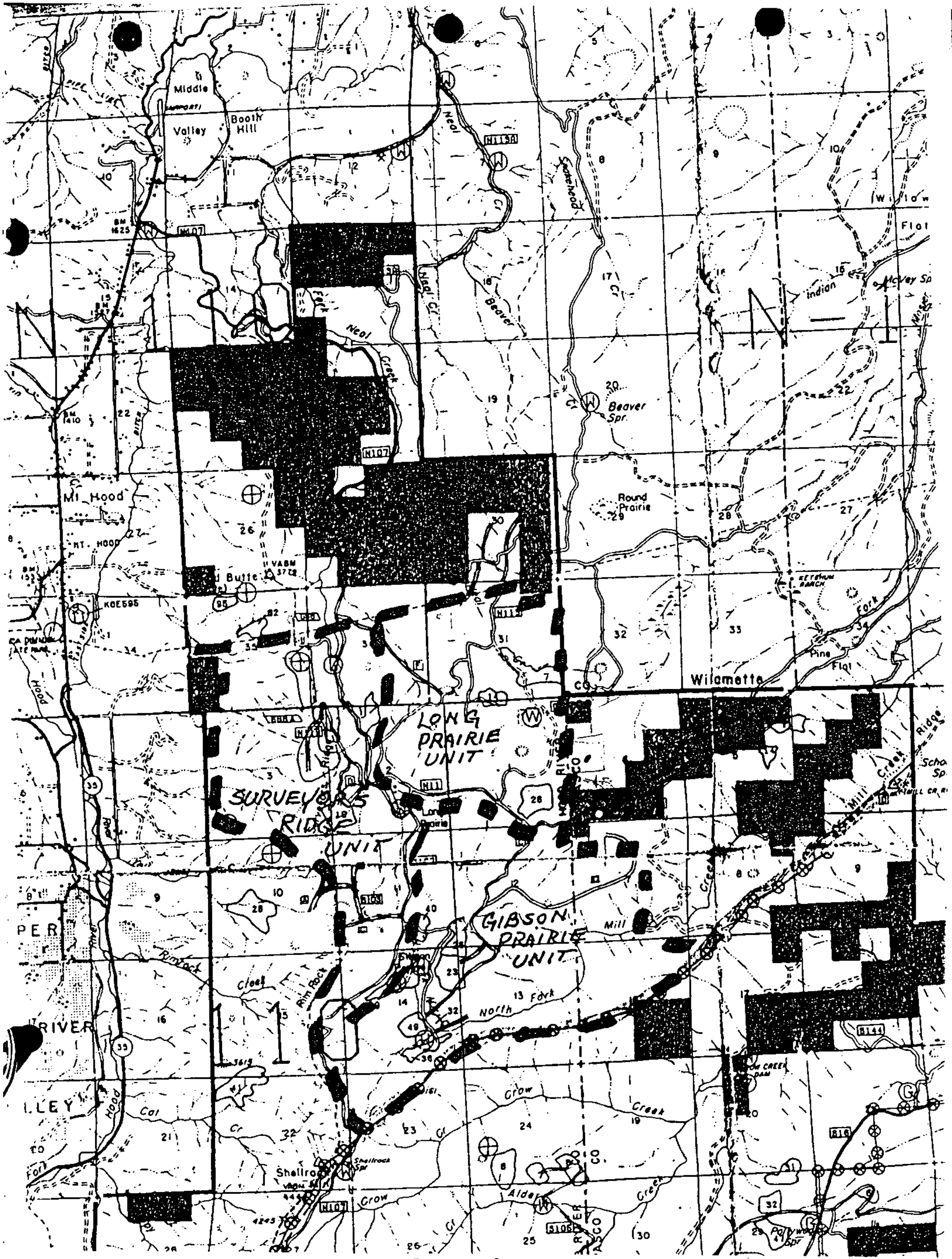
* These are total numbers for entire allotment. Not all of these numbers are within this portion of the analysis area every year.

Historical Levels

Grazing on the Mt. Hood National Forest has been documented as far back as the 1880's. This allotment specifically has documented records dating back to 1906. The current permittees have a very long history of operating in this area. One has been operating a permit here since 1940, while the other permittees father has maintained a permit here since the early 1920's.

Grazing Management/Strategies

The annual Operating Plan identifies a "three pasture, rest rotation" grazing system. This essentially has one of the three pastures being completely rested once every three years. The season of operating runs from June 15th to September 30th, depending on range readiness monitoring. There are numerous range improvments that have been constructed within this allotment to allow an even distribution of animals to prevent resource damage. These include fencing, water developments, and grass seedings. These improvements have basically been in place the last 40 years.
Dan Fissell - Range Conservationist


LONG PRAIRIE UNIT
SURVEYOR'S RIDGE UNIT
GIBSON PRAIRIE UNIT
Middle Valley
Booth Hill
Mt Hood
Round Prairie
Beaver Spr.
Willamette
Pine Flat
Neal Creek
Indian
McVey Sp
Willow Flat
Mill Creek Ridge
North Fork
Crow Creek
Rimrock Creek
Shellrock Spr
RIVER
LLEY
Hood River

Range-2

Appendix I
Insect and Disease

Mill Creek Watershed Analysis
Insects and Diseases

General

A range of native insects and diseases, and several exotic species, are found within the Mill Creek Watershed Analysis area. Those species which are capable of causing tree mortality or limiting tree growth to the extent of significantly the altering stand-level attributes which currently exist in the Mill Creek Watershed Analysis Area, are considered "important", and will be the focus of this discussion. The following species are included in this group: mountain pine beetle, western pine beetle, Douglas-fir beetle, fir engraver, western spruce budworm, annosus and armillaria root disease, laminated root rot, and dwarf mistletoe in Douglas-fir, ponderosa pine, and western larch (Table 1).

Table 1. Important insects and diseases in Mill Creek Watershed analysis plant series.

	Hot Dry Pine-Oak/ Doug-fir	Warm Dry Doug-fir/ Grand Fir	Dry Grand Fir	Moist Grand Fir
Douglas-fir beetle	X	X	X	X
Fir engraver[1]		X	X	X
Mountain pine beetle in lodgepole pine				X
Mountain/western pine beetle in ponderosa pine	X	X	X	
Western spruce budworm[2]	X	X	X	X
Annosus root rot[3]	X	X	X	X
Armillaria[4]	X	X	X	X
Laminated root rot[5]	X	X	X	X
Douglas-fir dwarf mistletoe	X	X	X	X
Larch dwarf mistletoe				X
Lodgepole pine dwarf mistletoe				X
Ponderosa pine dwarf mistletoe	X	X	X	

[1]Primary hosts are grand fir, white fir, and Pacific silver fir.
[2]Primary hosts include Douglas-fir, grand fir, white fir, and Pacific silver fir.
[3]Highly susceptible hosts include: S-strain: grand fir, white fir, and subalpine fir; P-strain: ponderosa pine.
[4]Highly susceptible hosts include Douglas-fir, grand fir, white fir, and sapling pines.
[5]Highly susceptible hosts include Douglas-fir, grand fir, white fir, mountain hemlock, and, to a somewhat lesser extent, Pacific silver fir.

Other species which cause noticeable effects, but whose effects are likely to have intermediate to low impact upon the current and future vegetative attributes of the watershed analysis area, include pine engraver, larch casebearer, balsam woolly adelgid, blackstain, and white pine blister rust. These species, while capable of causing important stand level effects, do not generally operate at the intensity and scale of the aforementioned "important" group of insects and diseases. Three of these, larch casebearer, balsam woolly adelgid, and white pine blister rust, are introduced species which have become established in our native forests. White pine blister rust has caused a significant decrease in the occurrence and vigor of western white pine throughout the West. As a result of white pine blister rust, western white pine in general comprises a much smaller percentage of stand composition than it did in the past, and future activity of the pathogen will likely have little effect upon the attributes of most stands in the watershed. Larch casebearer, while occasionally causing conspicuous defoliation on western larch, has never caused noticeable mortality in the Mill Creek Watershed analysis area. Balsam woolly adelgid effects were first recorded in the analysis area in

1955, but since 1973 are so subtle as to be unnoticed by routine aerial surveys. Mortality caused by pine engraver is frequently related to drought, and also to unmanaged slash production during logging. Blackstain may be of local importance in some areas.

Historic Range, Current Conditions, and Trends of Insect and Disease Disturbance Patterns

Historical patterns and intensities of insects and diseases are somewhat different in the analysis area than they were in presettlement times, particularly in plant associations with a history of frequent fire events. Insect and disease activity is largely a function of insect or pathogen presence, host abundance, stand conditions, landscape patterns, and weather events and patterns.

The greatest changes affected by man since presettlement times, which have influenced insect and disease disturbance patterns, have been the vegetative changes in stand conditions and landscape patterns brought about by fire exclusion and the selective logging of large pine. Significant vegetative changes that have resulted, to a large extent, from these two factors include denser stands, an increase in shade-tolerant species in mixed conifer stands that historically were predominantly pine, smaller average tree diameters, and more canopy layers. These changes have increased the frequency, scale and intensity of many insect and disease disturbance patterns, while decreasing the activity of others. Insect activity during the past fifty years has tended to occur most frequently in the upper portion of the Mill Creek drainage, within the Forest boundary.

Following are synopses of the "high-hazard" insects and diseases found in Figure 1 which briefly describe historical patterns, recorded history in the Mill Creek Watershed analysis area, and current trends. Several agents, such as the pine beetles, root diseases, and dwarf mistletoes, have been grouped for more economical discussion. Because of its historical significance as an influential exotic species, a brief synopsis of white pine blister rust is also included. Information was gathered from the 1933 and the 1938-46 Region 6 Insect and Disease Conditions Reports, from maps of Region 6 Insect Annual Aerial Detection Surveys, 1947-1997, excluding 1996, and from Current Vegetative Survey data, 1994-1996.

Douglas-fir beetle

Historical Pattern

Historically, widespread Douglas-fir beetle activity in the eastern Cascades has been strongly linked to windthrow events and western spruce budworm defoliation. Beetle populations increase in the abundant broken and down host material created by major windstorms, then attack standing green trees in subsequent years. Beetles are able to more easily overcome the defenses of live trees when they are placed under the stress caused by consecutive years of defoliation. Tree stress caused by drought and overstocking probably also play a role in Douglas-fir beetle activity in the analysis area. Outbreaks usually last only 3-4 years. Occasional small patches of beetle-killed Douglas-fir are commonly associated with root disease pockets.

Past 50 years

Heightened Douglas-fir beetle activity occurred in the analysis area during 1952-55, following the 1947-51 western spruce budworm outbreak and winter 1949-50 windthrow event. Some activity was reported in the early sixties, and again in the early seventies, following a January, 1970 ice storm in the Columbia River Gorge which caused severe winter damage in the Hood River Drainage. Another increase occurred in 1989-90, following the 1983-88 western spruce budworm outbreak, and drought periods of the late eighties and early nineties. The majority of Douglas-fir beetle activity occurred in the upper portion of the watershed, within the Forest boundary.

Trends

Douglas-fir beetle activity has probably increased somewhat over historic patterns in the analysis area. In some areas, heightened activity may have occurred as a result of certain logging practices (such as leaving green log decks in the woods for a year, and clearcutting, which frequently resulted in windthrow along forested edges) in the early to mid 1900's when much logging was taking place. Widespread outbreaks however, remain strongly associated with large-scale windthrow events. Since 1980, patches of aerially-detected mortality caused by the Douglas-fir beetle have occurred most frequently in Fire Exclusion Multistory and Late Seral Multistory stands.

Fir Engraver

Historical Pattern
Fir engraver outbreaks are associated with periods of drought and defoliator outbreaks. Scattered, occasional fir engraver activity is highly correlated with root disease.

Past 50 years
Fir engraver was active in the analysis area during the late 1960's and early 1970's. During the peak year of 1970, a very large number of trees over an area covering upper Crow Creek and Gibson Prairie, and over another area in the vicinity of Ketchum Ranch, were killed. Mortality from fir engraver was recorded regularly and increasingly throughout the 1980's and into the early 1990's, coinciding with the 1983-1988 western spruce budworm outbreak, and drought periods of the late 80's and early 90's. Another large outbreak occurred in 1995 in the upper portion of the Mill Creek watershed.

Trends
Fir engraver activity is probably more widespread than in presettlement times, due to increases in abundance and distribution of shade tolerant species in the mixed conifer forest types as a result of fire exclusion. Patches of aerially-detected mortality caused by the fir engraver between 1980 and 1997 occurred most frequently in Fire Exclusion Multistory stands. The intensity and frequency of fir engraver activity also are probably greater than in presettlement times, due to the effects of overstocking on fire excluded sites, and spread and intensification of root disease. Large-scale outbreaks of the fir engraver, however, remain strongly associated with drought and defoliation, and are probably no more frequent than in historical times.

Pine beetles (mountain pine beetle and western pine beetle)

Historical Pattern
The mountain pine beetle has been historically associated with mature, dense, lodgepole stands, overcrowded second growth ponderosa pine stands, and large, older western white pine in mixed species stands. Outbreaks can be widespread and are sometimes catastrophic, stand replacement events, especially in the pure lodgepole pine type. Mountain pine beetle activity is closely associated with trees of low vigor growing in overcrowded conditions.

The western pine beetle is historically associated with mortality of large ponderosa pine of declining or low vigor. In recorded history, the western pine beetle has been a major disturbance agent in ponderosa pine areas on the east side of the Mt. Hood National Forest. Large amounts of mortality of the large-diameter ponderosa pine component of these stands occurred from 1922 to 1942, according to Region 6 Forest Insect and Disease Conditions Reports:

"On the east side of this forest [Mt. Hood] in the marginal ponderosa pine areas on both private and National Forest timber heavy beetle losses have been in progress since 1922."--*from* Annual Report of the Forest Insect Conditions in Oregon and Washington for 1933.

"There are few ponderosa pine stands in the Pacific Northwest region so seriously depleted of mature pine timber by pine beetles as stands on the east side of the Mt. Hood National Forest. The beetles exacted an average toll of 7.2 percent of the stand in the years 1938 to 1942 and on the most heavily infested areas the loss was nearly twice as great. Infestation increased about 200 percent from 1937 to 1940, decreased considerably in 1941, and increased again in 1942."--*from* 1938 - 1942 Forest Insect Conditions in Oregon and Washington, July, 1946.

Two notable events were related to the regional-scale western pine beetle outbreak of that time. The first was a severe drought during 1929 and 1930, which reduced tree resistance and increased the number of trees susceptible to insect attack. The second was a major wind storm in April 1931 that blew down a "tremendous amount of trees throughout the region" creating a large amount of favorable brood habitat for the beetles.

Past 50 years

Annual aerial survey records indicate a fairly regular occurrence of pine beetles in the analysis area since 1947. Pine beetle activity in ponderosa pine (especially second growth) and white pine, markedly increased in intensity throughout the analysis area during 1969-1972, and increased again in 1991-1992, especially in second growth ponderosa pine, following drought periods in the late eighties and early nineties. Mountain pine beetle activity in lodgepole pine increased sharply in 1994 and appeared again in 1997.

Trends

Mountain pine beetle in lodgepole pine

The mountain pine beetle continues to act as a density dependent regulating agent in the lodgepole pine ecosystem. The frequency and scale of mountain pine beetle activity in lodgepole pine has probably increased over historical levels due to fire suppression. Since 1980, aerially-detected mortality caused by the mountain pine beetle has occurred in a variety of stand structure types, including Understory Reinitiation, Mature Stem Exclusion, and Fire Exclusion Multistory, among others.

Pine beetles in ponderosa pine

Mountain pine beetle activity has increased in scale, intensity, and frequency in overstocked second growth ponderosa pine stands when compared to presettlement levels. This is due to the greater frequency of stands of this type on the landscape in the 1900's, when widespread selective logging converted old growth ponderosa pine stands to second growth across the landscape. No strong correlation between mountain pine beetle activity in ponderosa pine and any particular stand structure type is evident from aerial survey data 1980 - 1997.

Over the last several decades, the *western pine beetle* has also been found attacking overcrowded second growth ponderosa pine stands in much the same manner as and sometimes in association with mountain pine beetle. This pattern-shift is evident in the analysis area, where the occurrence of large-diameter ponderosa pine across the landscape was severely reduced by the western pine beetle outbreak and associated logging during the twenties and thirties, and later by continued selective logging of large ponderosa pine. Thus the scale and intensity of western pine beetle activity has decreased in large-diameter pine, although the frequency of attack has probably increased in the remaining large trees (due lowered vigor resulting from crowding in fire excluded stands), while in second growth pine, the scale, intensity, and frequency of western pine beetle activity have increased. Since 1980, aerially-detected mortality caused by the western pine beetle has occurred most frequently in Fire Exclusion Multistory stands.

Western spruce budworm

Historical Pattern
Little information is available regarding the historic frequency, intensity, or duration of western spruce budworm outbreaks in the analysis area, but outbreaks probably occurred periodically throughout the host type. Research using tree ring analysis by Boyd Wickman1 and others on budworm outbreaks in the Blue Mountains of northeastern Oregon found that budworm outbreaks in that area did not appear to be more frequent in the twentieth century than during the 19th century. Budworm defoliation tends to kill a higher percentage of understory host trees than overstory host trees, due to budworm larval behavior and tree competition.

Past 50 years
Western spruce budworm defoliation occurred within the boundaries of the watershed in 1947-1951, 1983-1988, and 1994. Portions of the outbreak on the Mt. Hood were treated for budworm suppression during 1949 and 1950, but the analysis area did not fall within any of the treatment blocks. Defoliation covered a greater percentage of the analysis area for a longer period of time during the 1983 outbreak than it did during the one in 1947. Defoliation in 1947-1951 was restricted to National Forest lands, while in 1983-1988 defoliation at times extended beyond the Forest boundaries. During the 1983 outbreak, which also coincided with a period of drought that affected most of eastern Oregon, budworm defoliation was recorded at some point in nearly all susceptible host type.

Trends
Fire suppression and selective logging of non-host species has increased the extent and improved the quality of available budworm host type in the eastern Cascades, resulting in outbreaks that are more widespread and perhaps more intense than in presettlement times. Understory mortality across the outbreak landscape is probably greater than in historic times, due to higher amounts and densities of budworm host species occupying the lower canopy layers. Examination of aerial survey data 1980-1997 showed budworm occurring across all stand structure types containing host in the analysis area at one time or another during this period.

Dwarf mistletoes

Historical pattern
Fires largely determined the extent and amount of dwarf mistletoes during presettlement times. The distribution of dwarf mistletoes throughout the analysis area was probably limited in extent and low in intensity in most stands.

Current condition
The spread of dwarf mistletoes is favored by abundant host, dense stocking, multistoried conditions, and fire exclusion, all of which are common current conditions in the analysis area. Dwarf mistletoes currently are widespread throughout the mixed conifer type, and severe dwarf mistletoe infections, especially in Douglas-fir and western larch, are common in many areas[2].

Trends

1 Retired research entomologist, USDA Forest Service, Pacific Northwest Research Station, La Grande, OR.
2 1994-96 CVS plot data reports dwarf mistletoe on 6 out of 14 plots in the analysis area, with dwarf mistletoe ratings ranging from 1-6. Dwarf mistletoes were reported on ponderosa pine, Douglas-fir (most widely distributed), and grand fir. The 1983 intensive pest survey on the Crow Planning area by Forest Pest Management personnel reported dwarf mistletoes infecting Douglas-fir and western larch over 54 percent of the area, and further stated that mortality and severe infections in living trees were common throughout the entire area. Other similar pest surveys made in 1982 and 1983 across the Barlow district and outside the boundaries of the analysis area, indicate widespread dwarf mistletoe infections throughout the mixed conifer type in that area, with the most severe infestations occurring in western larch and Douglas-fir..

The distribution of dwarf mistletoes has increased in the analysis area since the advent of fire suppression in the early 1900's. For most species, infestations have become more severe in unmanaged stands, especially where fire has been excluded. It is also likely that dwarf mistletoe has also intensified in partial cut stands where infected overstory trees were left over a susceptible host understory.

Root diseases

Historical patterns
In presettlement times, mixed conifer stands in Douglas-fir and grand fir plant associations contained a higher proportion of the more root disease resistant pines and larches. Root disease pockets were, for the most part, probably small and scattered, although fairly high levels of laminated root rot could probably be found in some areas. This same pattern was also likely in the silver fir plant associations. In the mountain hemlock plant associations, laminated root rot centers were probably more frequent and larger in size. Annosus and armillaria root disease centers probably occurred at very low levels across the landscape. Armillaria root disease activity was associated with tree stress and intensified during periods of drought.

Current conditions
Root disease centers of armillaria and annosus root disease, and laminated root rot, are scattered throughout the analysis area. Extrapolation from CVS plot data would indicate that about 12 percent of the analysis area is affected by root disease levels high enough to diminish canopy cover[3]. Relatively high levels of root disease occur at some locations.[4]

Trends
Root diseases have probably intensified in the analysis area during the past 90 years, due to fire exclusion, which has resulted in increased occurrence and density of highly susceptible host species, regeneration of root disease centers with highly susceptible species, and widespread partial cutting. Partial cutting exacerbates root disease problems when trees are injured or their roots are compacted during logging operations on sites infected with armillaria root disease. Partial cutting also enhances the spread of annosus root disease to live residual trees by creating a scattered pattern of stumps with extensive root systems which are easily colonized by this root disease.

White pine blister rust

White pine blister rust spread to the Mt. Hood National Forest during the period of 1921-1930. The mid-1950's marked its first appearance on annual insect detection survey maps of the Forest. However, no mortality of western white pine for any agent was recorded in the Mill Creek Watershed Analysis Area until 1966. Although this mortality was coded as mountain pine beetle, it may have actually been caused by a combination of mountain pine beetle and

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[3] Fourteen CVS plots containing 67 sample points fall within the boundaries of the Mill Creek Watershed Analysis area (each plot usually contains 5 sample points on which tree information is gathered). During 1994-1996, root disease was recorded on one or more sample points within each of the 14 sample plots. Thirty-seven percent (25 out of 67) of the sampled points contained trees which were coded for root disease. Nine percent (142 out of 1605) of the total trees sampled on all plots had a root disease damage code, indicating the tree either had signs or symptoms of root disease, or were located within 30 feet of a tree which had signs or symptoms of root disease. Twelve percent (8 out of 67) of the sample points had overall root disease ratings of 3 to 5 (0-1, very low; 2-3, low; 4-5, moderate; 6-9, high). Overall root disease rating values of 3 through 9 indicate increasing levels of canopy cover reduction resulting from root disease activity.

[4] An intensive pest survey completed by Forest Pest Management personnel in 1983 on the Crow Planning Unit, located along the north side of Crow Creek, found 33 percent of the area covered by laminated root rot disease centers.

white pine blister rust. Subsequent to 1966, white pine mortality has been recorded in the analysis area during each decade to the present. From the air, white pine mortality due to blister rust, or a combination of blister rust and mountain pine beetle, is usually indistinguishable from that caused by the mountain pine beetle acting alone. Unless verifying ground checks are made, the exact cause of white pine mortality which has been coded as mountain pine beetle remains uncertain, but it is fairly safe to assume that at least some of that mortality represents the effects of blister rust infection.

Summary

With the exception of western pine beetle in large ponderosa pine, the distribution, and in some cases, the intensity, of insect -caused tree mortality and forest pathogens appear to have increased over historic, presettlement levels in the Mill Creek analysis area. Fire exclusion has contributed to this increase. This trend is likely to continue until stand density and host abundance for the various disturbance agents are reduced toward historic levels.

Insect and Disease Hazard Guide

Hazard Defined

For purposes of this analysis, hazard is defined as: *the set of conditions which indicate a stand is likely to undergo significant alteration in structure, composition, or density as a result of the activity of a correlated disturbance agent (insect or disease).* Stands identified as having hazard are very likely to undergo significant alteration due to insects or disease (and associated subsequent wildfire), should sustained disturbance activity or an outbreak event for which the hazard is identified occur within the stand.

Potential Effects of Insect and Disease Activity

Insects and diseases affect stands in various ways, and at various levels of intensity, depending upon the host preferences and abundance of the insect or pathogen, the characteristics of the stand, and climatological events. Table 2 lists significant structural, compositional, and density-related alterations which may occur in stands with hazard for one or more disturbance agents. Many of these alterations are interrelated, but they have been selected as effects descriptors because of their generally recognized importance to stand dynamics and function. These alterations are displayed later in the Insect and Disease Hazard sections; for each insect in the appropriate hazard matrix intersections in Tables 3-8, and for each disease in the applicable text section.

Table 2. Potential stand-level effects of a disturbance event in stands with hazard.

Significant Alteration
1 - Reduced Tree Density
2 - Smaller Average Stand Diameter
3 - Larger Average Stand Diameter
4 - Fuels Increase
5 - Increase in Standing Dead/Coarse Woody Debris
6 - Creation of Gaps
7- Accelerated Conversion to Non-Host in Absence of Fire
8 - Conversion to Multi-Story Canopy
9 - Understory Canopy Reduction
10 - Loss of Large Overstory Pine Component
11 - Stand Destruction/Replacement in Pure or Nearly Pure Host Stands

Hazard Matrices

Matrices displaying areas where hazard for several "high risk" insects may occur within the vegetative types and stand structural classes that occur within the analysis area are shown in Tables 3-8. Guidelines for hazard thresholds in individual stands are listed below each matrix. Dwarf mistletoes and root diseases are not displayed in this fashion, rather, hazardous conditions are addressed in sections of text.

How To Use This Hazard Guide

Hazard may be rated for individual stands, or for collections of stands such as watersheds, *if* the hazard paramaters are known for each stand. Important hazard parameters are species, diameter, stand basal area, number of canopy layers, presence or absence of pathogens. Most, if not all, of this information is taken during standard stand exam inventories. Each stand may be rated for hazard by applying the stand hazard thresholds (shown beneath the hazard matrix for insects; in the hazard section of text for diseases) for each agent. Significant alterations which are likely to occur in a stand as a result of a disturbance event for a particular hazard are depicted on the matrix for additional

information. Collections of stands may be rated for hazard by individually rating each stand, and then displaying hazard as a percentage of area. Various management scenarios may then be evaluated based on reduction of hazard.

Disease Hazard

Dwarf Mistletoes - Hazardous Conditions

Dwarf mistletoes of concern in the analysis area are indicated in Table 1. Following is a list of stand conditions which favor the spread and intensification of dwarf mistletoes:

1) Stands with 30 percent or more of the host species.
2) A multistoried host component which is infected (at any level) with dwarf mistletoe.
3) Infected overstory not removed or killed before host understory becomes infected (infections in understory trees usually are fairly uncommon until they reach about 3 feet in height).
4) For single-storied pine stands: hazard exists if the average Hawksworth stand dwarf mistletoe rating is equal to or greater than 3.

Potential Effects (from Table 2)
Fuels increase.

Laminated Root Rot - Hazardous Conditions

Hazardous conditions for the spread and intensification of laminated root rot occur when the disease is identified as present in the stand and the following management actions occur:

1) Highly susceptible species (see Table 1) are established on diseased areas.
2) During partial cuts, residual trees of highly susceptible species are favored or retained.

Potential Effects (from Table 2)
Reduced tree density, fuels increase, increase in standing dead (short term)/coarse woody debris, creation of gaps.

Annosus Root Disease - Hazardous Conditions

Hazardous conditions for the spread and intensification of annosus root disease occurs when:

1) Highly susceptible species (see Table 1) are established on diseased areas.
2) During partial cuts, residual trees of highly susceptible species are favored or retained in stands where the disease is present.
3) Stands containing greater than 50 percent true fir are partially cut without treating stumps to prevent infection.

Potential Effects (from Table 2)
Reduced tree density, fuels increase, increase in standing dead (short term)/coarse woody debris, creation of gaps.

Armillaria Root Disease - Hazardous Conditions

Hazardous conditions for the spread and intensification of armillaria root disease occurs when:

1) Highly susceptible species (see Table 1) are established on diseased areas.
2) During partial cuts, residual trees of highly susceptible species are favored or retained in stands where the disease is present.
3) High levels of compaction and tree damage occur during logging operations in stands where the disease is present

Potential Effects (from Table 2)
Reduced tree density, fuels increase, increase in standing dead (short term)/coarse woody debris, creation of gaps.

Legend for Tables 1-5 (on following pages)

1,2,5

Potential Hazard. Numerals represent significant alterations that may occur in a stand as a result of the specified disturbance event. Resulting alterations depend upon initial stand characteristics and conditions, and the intensity, duration, and frequency of disturbance.

List of Significant Alterations

1 - Reduced Tree Density
2 - Smaller Average Stand Diameter
3 - Larger Average Stand Diameter
4 - Fuels Increase
5 - Increase in Standing Dead/Coarse Woody Debris
6 - Creation of Gaps
7- Accelerated Conversion to Non-Host in Absence of Fire
8 - Conversion to Multi-Story Canopy
9 - Understory Canopy Reduction
10 - Loss of Large Overstory Pine Component
11 - Stand Destruction/Replacement in Pure or Nearly Pure Host Stands

Table 1. Hazard matrix for Douglas-fir beetle.

	Cool-Moist ABAM	Cool-Moist ABGR	Moist ABGR	Dry ABGR	PSME	PIPO-QUGA	THPL-ABGR/ ACTR (Rip.
Trees 20"+ Closed canopy 1-2 stories	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,2,4,5,6	PIEN PSME LAOC ABGR PIMO *PIEN* *ABGR* 1,2,4,5,6	ABGR PSME LAOC *ABGR* 1,2,4,5,6	ABGR PSME PIPO *ABGR* 1,2,4,5,6	PSME PIPO *PSME* 1,2,4,5,6	PIPO *PIPO*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Trees 20"+ Open canopy 1-2 stories					PSME PIPO *PSME* 1,2,4,5,6	PIPO *PIPO* *QUGA*	
Trees 20"+ Multistory	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,2,4,5,6	PIEN PSME LAOC ABGR PIMO *PIEN* *ABGR* 1,2,4,5,6	ABGR PSME LAOC *ABGR* 1,2,4,5,6	ABGR PSME PIPO *ABGR* 1,2,4,5,6	PSME PIPO *PSME* 1,2,4,5,6	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Trees 9-20" Closed canopy 1-2 layers	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,2,4,5,6	PIEN PSME LAOC ABGR PIMO *PIEN* *ABGR* 1,2,4,5,6	ABGR PSME LAOC *ABGR* 1,2,4,5,6	ABGR PSME PIPO *ABGR* 1,2,4,5,6	PSME PIPO *PSME* 1,2,4,5,6	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
"Doghair"	PIMO PSME LAOC ABAM PIEN 1,2,4,5,6	PIEN PSME LAOC ABGR PIMO 1,2,4,5,6	ABGR PSME LAOC 1,2,4,5,6	ABGR PSME PIPO 1,2,4,5,6	PSME PIPO 1,2,4,5,6	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME
Trees 9-20" Open OS/Dense US	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN* *ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR*	PSME PIPO *PSME*	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Trees 5-9" Closed canopy 1 layer	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
"Doghair"	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
Trees <5" Plantations	PSME PIEN LAOC PICO PIPO	PSME PIEN LAOC PICO PIPO	PSME LAOC PIPO	PSME PIPO	PSME PIPO	PIPO	PSME PIEN PIPO

Closed canopy = 60-100%; Open canopy = 30-60%; doghair = 100%. Overstory trees are in regular type, understory reproducing trees are in italics.

Stand Hazard Thresholds

% PSME ≥ 9"		DBH of PSME ≥ 9"*		Stand Basal Area* (sq ft)
≥ 30	and	≥ 14	and	≥ 250

*based on Steele et al. 1996 USDA FS Gen. Tech. Rep. INT-GTR-332

Table 2. Hazard matrix for fir engraver.

	Cool-Moist ABAM	Cool-Moist ABGR	Moist ABGR	Dry ABGR	PSME	PIPO-QUGA	THPL-ABGR/ ACTR (Rip.
Trees 20"+ Closed canopy 1-2 stories	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,4,5,6,8	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,4,5,6,8	ABGR PSME LAOC *ABGR* 1,4,5,6,8	ABGR PSME PIPO *ABGR* 1,4,5,6,8	PSME PIPO *PSME*	PIPO *PIPO*	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 20"+ Open canopy 1-2 stories					PSME PIPO *PSME*	PIPO *PIPO* QUGA	
Trees 20"+ Multistory	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,4,5,6	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,4,5,6	ABGR PSME LAOC *ABGR* 1,4,5,6	ABGR PSME PIPO *ABGR* 1,4,5,6	PSME PIPO *PSME*	PIPO *PIPO* QUGA	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 9-20" Closed canopy 1-2 layers	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,4,5,6,8	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,4,5,6,8	ABGR PSME LAOC *ABGR* 1,4,5,6,8	ABGR PSME PIPO *ABGR* 1,4,5,6,8	PSME PIPO *PSME*	PIPO *PIPO* QUGA	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
"Doghair"	PIMO PSME LAOC ABAM PIEN 1,4,5,6,8	PIEN PSME LAOC ABGR PIMO 1,4,5,6,8	ABGR PSME LAOC 1,4,5,6,8	ABGR PSME PIPO 1,4,5,6,8	PSME PIPO	PIPO *PIPO* QUGA	THPL TSHE ABGR PIEN PSME
Trees 9-20" Open OS/Dense US	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,4,5,6,8	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,4,5,6,8	ABGR PSME LAOC *ABGR* 1,4,5,6,8	ABGR PSME PIPO *ABGR* 1,4,5,6,8	PSME PIPO *PSME*	PIPO *PIPO* QUGA	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 5-9" Closed canopy 1 layer	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
"Doghair"	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
Trees <5" Plantations	PSME PIEN LAOC PICO PIPO	PSME PIEN LAOC PICO PIPO	PSME LAOC PIPO	PSME PIPO	PSME PIPO	PIPO	PSME PIEN PIPO

Closed canopy = 60-100%; Open canopy = 30-60%; doghair = 100%. Overstory trees are in regular type, understory reproducing trees are in italics.

Stand Hazard Thresholds

%ABGR+ABAM+ABCO		% Area covered by root disease
≥ 30	and	≥ 30

Table 3. Hazard matrix for mountain pine beetle in lodgepole pine.

	Cool-Moist ABAM	Cool-Moist ABGR	Moist ABGR	Dry ABGR	PSME	PIPO-QUGA	THPL-ABGR/ ACTR (Rip.
Trees 20"+ Closed canopy 1-2 stories	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR*	PSME PIPO *PSME*	PIPO *PIPO*	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 20"+ Open canopy 1-2 stories					PSME PIPO *PSME*	PIPO *PIPO QUGA*	
Trees 20"+ Multistory	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR*	PSME PIPO *PSME*	PIPO *PIPO QUGA*	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 9-20" Closed canopy 1-2 layers	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR*	PSME PIPO *PSME*	PIPO *PIPO QUGA*	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
"Doghair"	PIMO PSME LAOC ABAM PIEN	PIEN PSME LAOC ABGR PIMO	ABGR PSME LAOC	ABGR PSME PIPO	PSME PIPO	PIPO *PIPO QUGA*	THPL TSHE ABGR PIEN PSME
Trees 9-20" Open OS/Dense US	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR*	PSME PIPO *PSME*	PIPO *PIPO QUGA*	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 5-9" Closed canopy 1 layer	PSME PIEN LAOC PICO 1,2,4,5,6,7,8,11	PSME PIEN LAOC PICO 1,2,4,5,6,7,8,11	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
"Doghair"	PSME PIEN LAOC PICO 1,2,4,5,6,7,8,11	PSME PIEN LAOC PICO 1,2,4,5,6,7,8,11	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
Trees <5" Plantations	PSME PIEN LAOC PICO PIPO	PSME PIEN LAOC PICO PIPO	PSME LAOC PIPO	PSME PIPO	PSME PIPO	PIPO	PSME PIEN PIPO

Closed canopy = 60-100%; Open canopy = 30-60%; doghair = 100%. Overstory trees are in regular type, understory reproducing trees are in italics.

Stand Hazard Thresholds

% PICO		DBH of PICO ≥ 5"		Stand Basal Area* (sq ft)
≥ 50	and	≥ 8	and	≥ 90

* based on Cochran et al 1994 Upper Management Zones

Table 4. Hazard matrix for pine beetles[1] in ponderosa pine.

	Cool-Moist ABAM	Cool-Moist ABGR	Moist ABGR	Dry ABGR	PSME	PIPO-QUGA	THPL-ABGR/ ACTR (Rip.
Trees 20"+ Closed canopy 1-2 stories	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR* 1,2,4,5,6,7,8,10	PSME PIPO *PSME* 1,2,4,5,6,7,8,10,11	PIPO *PIPO* 1,2,4,5,6,8,10,11	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 20"+ Open canopy 1-2 stories					PSME PIPO *PSME*	PIPO *PIPO* *QUGA*	
Trees 20"+ Multistory	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR* 1,2,4,5,6,7,10	PSME PIPO *PSME* 1,2,4,5,6,7,10,11	PIPO *PIPO* *QUGA* 1,2,4,5,6,10,11	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 9-20" Closed canopy 1-2 layers	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR* 1,2,4,5,6,7,8,10	PSME PIPO *PSME* 1,2,4,5,6,7,8,10,11	PIPO *PIPO* *QUGA* 1,2,4,5,6,8,10,11	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
"Doghair"	PIMO PSME LAOC ABAM PIEN	PIEN PSME LAOC ABGR PIMO	ABGR PSME LAOC	ABGR PSME PIPO 1,2,4,5,6,7,8,10	PSME PIPO 1,2,4,5,6,7,8,10,11	PIPO *PIPO* *QUGA* 1,2,4,5,6,8,10,11	THPL TSHE ABGR PIEN PSME
Trees 9-20" Open OS/Dense US	PIMO PSME LAOC ABAM PIEN *ABAM PIEN*	PIEN PSME LAOC ABGR PIMO *PIEN ABGR*	ABGR PSME LAOC *ABGR*	ABGR PSME PIPO *ABGR* 1,2,4,5,6,7,10	PSME PIPO *PSME* 1,2,4,5,6,7,10	PIPO *PIPO* *QUGA* 1,2,4,5,6,7,8,10	THPL TSHE ABGR PIEN PSME *THPL TSHE ABGR PIEN*
Trees 5-9" Closed canopy 1 layer	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO 1,2,4,5,6,7,8	PSME PIPO 1,2,4,5,6,7,8,11	PIPO 1,2,4,5,6,8,11	PSME PIEN ABGR
"Doghair"	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO 1,2,4,5,6,7,8	PSME PIPO 1,2,4,5,6,7,8,11	PIPO 1,2,4,5,6,8,11	PSME PIEN ABGR
Trees <5" Plantations	PSME PIEN LAOC PICO PIPO	PSME PIEN LAOC PICO PIPO	PSME LAOC PIPO	PSME PIPO	PSME PIPO	PIPO	PSME PIEN PIPO

[1] Mountain pine beetle and western pine beetle

Closed canopy = 60-100%; Open canopy = 30-60%; doghair = 100%. Overstory trees are in regular type, understory reproducing trees are in italics.

Stand Hazard Thresholds

	% Pines		DBH of pines ≥ 5"		Stand Basal Area* (sq. ft.)
For stand hazard:	≥ 50	and	≥ 8	and	≥ 120 (Dry ABGR) ≥ 100 (PSME) ≥ 80 (PIPO-QUOA)
For remnant old growth overstory in mixed conifer hazard:	≥ 10	and	DBH of pines ≥ 16" ≥ 20	and	

*based on Cochran's 1992 Upper Management Zones

Table 5. Hazard matrix for western spruce budworm.

	Cool-Moist ABAM	Cool-Moist ABGR	Moist ABGR	Dry ABGR	PSME	PIPO-QUGA	THPL-ABGR/ ACTR (Rip.
Hazard for stands with 2 layers Trees 20"+ Closed canopy 1-2 stories	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,3,4,9	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,3,4,9	ABGR PSME LAOC *ABGR* 1,3,4,9	ABGR PSME PIPO *ABGR* 1,3,4,9	PSME PIPO *PSME* 1,3,4,9	PIPO *PIPO*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Trees 20"+ Open canopy 1-2 stories					PSME PIPO *PSME*	PIPO *PIPO* *QUGA*	
Trees 20"+ Multistory	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,3,4,5,6,9	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,3,4,5,6,9	ABGR PSME LAOC *ABGR* 1,3,4,5,6,9	ABGR PSME PIPO *ABGR* 1,3,4,5,6,9	PSME PIPO *PSME* 1,3,4,5,6,9	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Hazard for stands with 2 layers Trees 9-20" Closed canopy 1-2 layers	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,3,4,5,6,9	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,3,4,5,6,9	ABGR PSME LAOC *ABGR* 1,3,4,5,6,9	ABGR PSME PIPO *ABGR* 1,3,4,5,6,9	PSME PIPO *PSME* 1,3,4,5,6,9	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
"Doghair"	PIMO PSME LAOC ABAM PIEN 4,5,6	PIEN PSME LAOC ABGR PIMO 4,5,6	ABGR PSME LAOC 4,5,6	ABGR PSME PIPO 4,5,6	PSME PIPO 4,5,6	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME
Trees 9-20" Open OS/Dense US	PIMO PSME LAOC ABAM PIEN *ABAM PIEN* 1,3,4,6,9	PIEN PSME LAOC ABGR PIMO *PIEN ABGR* 1,3,4,6,9	ABGR PSME LAOC *ABGR* 1,3,4,6,9	ABGR PSME PIPO *ABGR* 1,3,4,6,9	PSME PIPO *PSME* 1,3,4,6,9	PIPO *PIPO* *QUGA*	THPL TSHE ABGR PIEN PSME *THPL* *TSHE ABGR* *PIEN*
Trees 5-9" Closed canopy 1 layer	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
"Doghair"	PSME PIEN LAOC PICO	PSME PIEN LAOC PICO	PSME LAOC	PSME PIPO	PSME PIPO	PIPO	PSME PIEN ABGR
Trees <5" Plantations	PSME PIEN LAOC PICO PIPO	PSME PIEN LAOC PICO PIPO	PSME LAOC PIPO	PSME PIPO	PSME PIPO	PIPO	PSME PIEN PIPO

Closed canopy = 60-100%; Open canopy = 30-60%; doghair = 100%. Overstory trees are in regular type, understory reproducing trees are in italics.

Stand Hazard Thresholds

	% PSME + ABGR + ABAM + ABCO		Stand Basal Area (sq ft)
For Open OS/Dense US:	≥ 30 (OS), ≥ 30 (US)	and	Densely Stocked
For other stand structures:	≥ 30		

Appendix J
Fisheries

Mill Creek Watershed Analysis
Fisheries Report

Gary Asbridge

Introduction

Compared with other watersheds within the Eastern portion of the Mt. Hood National Forest, there has been relatively little information collected concerning fish population abundance, species distribution, and habitat quality and quantity within the Mill Creek Watershed. Most of the information available is associated with The Dalles Watershed land management and water quality. This report focuses on fish populations and habitat within the Mt. Hood National Forest although downstream areas are discussed when information was available.

Fish Species

Species presence and distribution likely has not changed a great deal since historic (i.e. pre-white man settlement) times although there have certainly been changes in relative abundance and migration patterns due to human activities. Steelhead trout *Oncorhynchus mykiss* were known to ascend Mill Creek and then South Fork Mill Creek up to Mill Creek Falls at river mile (RM) 2.8. There is a good possibility that steelhead used North Fork Mill Creek as well but there are no substantiated reports of steelhead use. Resident rainbow trout *O. mykiss* and sculpin *Cottus sp.* were present in Mill Creek, up to the falls in South Fork Mill Creek, and likely in North Fork Mill Creek. Dace *Rhinichthys sp.* were found in Mill Creek just below the confluence of North and South Mill Creek in 1983 but not further upstream, suggesting they were present in the system historically but their overall distribution is unknown. Cutthroat trout *O. clarki* were present in the South Fork Mill Creek sub-watershed above the falls, including Alder and Crow Creeks.

A lumber transport flume was constructed from the site of the current reservoir (about six miles upstream from the falls) that carried logs from John's Mill down to a site in The Dalles. This flume was built in late 1880's and not only transported logs but also provided irrigation, washing and drinking water for local residents. This flume was not screened so fish could have entered the flume and traveled downstream. The flume would not have impacted anadromous fish, as the inlet was above the falls, unless the outlet was situated so that ascending adults could enter the flume instead of continuing upstream in Mill Creek.

Local residents fished in South Fork Mill Creek in the early 1900's and fishing was considered a popular pastime (Bailey 1972). The Dalles Watershed was given protected status as a domestic water source in 1912 and at that time fishing was banned above the treatment plant. More than likely fishing occurred below the falls, both for resident rainbow and steelhead trout, both by indigenous people and white settlers. Commercial fishing on the Columbia River was already well underway prior to 1900 and likely impacted local anadromous fish runs.

Crow Creek Dam was constructed in 1967 across South Fork Mill Creek at RM 8.8 to provide additional drinking water for the city of The Dalles. An impact report was prepared prior to construction and fisheries was touched upon. Apparently, few, if any, surveys were conducted because the report states resident fish were not found in the vicinity of the soon to be constructed dam. The document also stated the watershed as a whole did not have good fishing, few resident fish were present, there was a lack of good fish habitat above the dam sites, and that the state did not stock fish in the area.

Since the falls downstream precluded anadromous and resident fish migration upstream the biggest initial impact from the dam was to effectively isolate cutthroat populations above the dam from those between the dam and the falls (although downstream passage is possible when water is spilled over the dam). Using Crow Creek Reservoir to rear anadromous fish, presumably steelhead, was considered by state and federal agencies but the program was never implemented.

There was an immediate problem with algae blooms in the reservoir which, if left untreated, plugged filters at the Wicks treatment plant and had the potential to cause offensive odors and tastes in city drinking water. To control algae the city applied sporadic doses of copper sulfate crystals both in the reservoir and South Fork Mill Creek near the reservoir outlet. Dissolved copper can be toxic to fish, particularly salmonids, under certain ambient water chemistry conditions. It appears there were negative impacts to aquatic fauna as a result of copper sulfate treatments because fish population sampling conducted by USDA Forest Service (USFS) personnel in 1982 and by Oregon Department of Fish and Wildlife (ODFW) in 1983 yielded no fish in South Fork Mill Creek immediately below the dam and very few fish as far as four miles below the dam. Sampling within the reservoir was not conducted so impacts to fish in the reservoir, if any, were not assessed. A report to the land use planning team, presumably for the Mt. Hood National Forest, on fishery resources within the watershed indicated that copper sulfate levels were too low to harm fish in the reservoir. The basis for this assertion is unknown as is the report author and writing date, but based on information within the report it was likely written in the early 1970's. Aquatic insects may also have been affected as there were differences in species composition and abundance immediately below the dam as compared to other sites up and downstream.

Copper sulfate treatments were discontinued in 19??. Based on USFS stream surveys conducted in 1991, cutthroat trout have recolonized South Fork Mill Creek in the four mile reach below the reservoir, however population abundance is unknown. Recovery of aquatic insects is assumed but no surveys have been conducted.

Current species distribution: Steelhead trout are found in Mill Creek and South Fork Mill Creek upstream to the falls. Presence is suspected in North Fork Mill Creek but has not been documented (Steve Pribyl, ODFW, personal communication). Water is diverted at Wicks treatment plant and piped to The Dalles, resulting in an essentially dewatered reach between the treatment plant and the confluence of North and South Fork Mill Creek (about one mile) during most summers. Overall impacts to both resident and anadromous fish in this reach are unknown but any salmonid stranded in this reach during this time period is likely to perish. This dewatered section also is a migration barrier. Depending on the time of year this section is dewatered there could be impacts to steelhead trout trying to move upstream to spawn. Resident rainbow trout, sculpin and dace are also found in this same area of the watershed. Rainbow trout presence in North Fork Mill Creek is likely but not verified (Steve Pribyl, ODFW, personal communication). One cutthroat trout was captured by ODFW in 1983 below the falls and above the water treatment plant. This trout could have come over the falls from upstream or could indicate a cutthroat trout population below the falls.

Above the falls only cutthroat trout and sculpin are found. Sculpin were noted in South Fork Mill Creek above the reservoir in 1983 but their upper limit of distribution in this stream, as well as presence/absence in Crow and Alder Creeks, is unknown. Cutthroat trout distribution has not been verified by electrofishing but approximations of the upper limits of distribution are possible based upon 1991 USFS stream surveys. In South Fork Mill Creek cutthroat were seen upstream from the reservoir approximately 3.0 miles. No obvious barriers were seen although a long, steep riffle slightly upstream from the last fish seen could be a barrier. An aqueduct from Dog River, In the Hood River Watershed, carries an additional supply of water for the city of The Dalles. The aqueduct empties into South Fork Mill Creek, augmenting streamflows and possibly providing a travel corridor for cutthroat trout from Dog River to the Mill Creek watershed. The aqueduct is not screened and removes virtually all the water from Dog River at that point. Cutthroat trout do inhabit Dog River.

The other two tributaries to the reservoir also contain resident populations of cutthroat trout. Cutthroat trout were seen in Crow Creek upstream approximately 3.0 miles after which intermittent stream conditions are a likely barrier to fish, at least in summer and fall. In Alder Creek cutthroat trout were noted upstream approximately 0.8 miles above the reservoir. Intermittent stream conditions were a barrier to fish at the time of the survey.

Fish captured in Crow Creek Reservoir with gill nets in 1993 were all cutthroat trout. These fish were generally smaller and had lower condition factors compared to other lake cutthroat trout populations on the Mt. Hood National Forest. A common descriptor for these fish was "torpedo" because they were long and skinny with relatively large heads. Not enough population information has been collected to determine the cause of this trend but a plausible

explanation is that there are too many fish in the reservoir for the available food supply to provide for large, "trophy" sized fish.

Fish Habitat

The following fish habitat summary is based on information collected in Mill Creek Watershed streams within the Mt. Hood National Forest in 1990 and 1991. Crow Creek Reservoir was also surveyed in 1993. Completed surveys can be found at the Mt. Hood National Forest HQ or at the Barlow Ranger District.

The three streams above Crow Creek Reservoir were similar in their basic characteristics although Alder Creek had more pool habitat and much more large woody debris (LWD) than the other two streams (Table 1). In fact Alder Creek was the only stream that met both Mt. Hood National Forest Land and Resource Management Plan (LRMP) and PACFISH standards and guidelines for LWD. None of the streams met LRMP or PACFISH standards for pools per mile.

South Fork Mill Creek below the reservoir was similar in some respects to above reservoir conditions but pool/riffle ratio and LWD was quite different (Table 1). It is curious that the pool/riffle ratio below the reservoir was one pool for every two riffles as opposed to one pool for every 32 riffles above the reservoir but there were similar numbers of pools per mile in both locations. Either the pools and riffle were very long below the reservoir or there was a difference in survey technique, surveyor bias, or a data analysis error. The very low numbers of large wood in the channel below the reservoir may indicate LWD removal in the past by settlers and/or local or federal agencies. In any case, South Fork Mill Creek below the reservoir did not meet either LRMP or PACFISH standards for LWD or pools per mile.

Flooding in February 1996 affected in-stream and riparian conditions throughout the watershed, particularly below the water treatment plant. Higher elevation streams and those with steeper gradients, such as the three streams above the reservoir, likely did not change as much as streams lower in the watershed due to lower magnitude of flood effects above 3000 ft and inherent stability of these stream types. However, if stream surveys were conducted today there would likely be some significant differences in channel characteristics compared to those found in 1990 and 1991.

Table 1. Summary of stream survey statistics for streams in the Mill Creek Watershed within the Mt. Hood National Forest. Except for South Fork Mill Creek below the reservoir, surveyed in 1991, all streams were surveyed in 1990.

	Alder Creek	Crow Creek	S.F. Mill Creek (above res.)	S.F. Mill Creek (below res.)
Length surveyed (mi)	0.9	3.2	3.6	3.0
Avg. gradient	5%	3%	6%	3%
P:R ratio	1:24	1:32	1:32	1:2
Pools/mile	12.1	7.8	5.6	11.3
Residual pool depth (ft)	1.5	1.7	1.7	1.4
Small LWD/mi	138	45	76	3
Large LWD/mi	34	17	18	4
Total LWD/mi	172	62	94	7
W/D ratio	6.0	5.8	7.5	8.5
Dominant sub-strate	Cobble	Cobble	Cobble	Cobble

Riparian vegetation in the three streams above the reservoir was dominated by Douglas fir with western redcedar subdominant. White fir and hemlock were also present. In the first floodplain (i.e. close to the creeks), alder and vine maple were the prevalent vegetation types. Stream shading for all three streams was greater than 60%.

Along South Fork Mill Creek below the reservoir Douglas fir and western redcedar were the dominant species in the upland portion of the riparian zone. In the immediate floodplain vine maple and alder were the most abundant. Stream shading ranged from 30% to 60% in this stream reach.

There is no stream habitat survey information for North Fork Mill Creek in its entirety and for South Fork Mill Creek or Mill Creek below the Mt. Hood National Forest boundary. North Fork Mill Creek is perennial at least at the forest boundary and is likely fish bearing as well but no surveys have been conducted.

Crow Creek Reservoir: Crow Creek Reservoir (also known as John's Mill Lake) is a 26 acre impoundment at 2600 ft elevation. The purpose of the reservoir, as stated above, is to provide drinking water for the city of The Dalles. The reservoir has two inlets, Crow and S.F. Mill Creeks, but only one outlet. Dog River, a tributary to the East Fork Hood River, is also a water source for the reservoir. Water is piped from Dog River and empties into South Fork Mill Creek upstream from the inlet.

Maximum water depth in the reservoir was 65 ft., deep enough to stratify at about 50 ft, which means there is a very cold, anoxic layer below 50 ft. This area cannot support fish or other aquatic organisms except bacteria and such that do not need oxygen to survive. The reservoir was mesotrophic, meaning the water body is "middle of the road" for organic productivity and nutrient input. Cutthroat trout, zooplankton (floating aquatic animals), phytoplankton (floating aquatic plants), and aquatic insects were all found in the reservoir.

The riparian zone ranged from 60 - 80 ft wide around most of the reservoir. The drawdown zone contained very little vegetation, the remainder was a mixture of sedges, grasses, and various amounts of deciduous trees such as alder, willow, manzanita, vine maple, and cottonwood. Some conifers were found in the riparian zone and the forest surrounding the lake was dominated by Douglas fir and Ponderosa pine.

Flow is discharged from the bottom of the reservoir and that contributes to water temperatures that are generally below the Oregon State standard. The reservoir also acts to reduce daily variations in water temperature, at least in the reach immediately below the reservoir. Using 1994 as an example, the daily maximum, minimum and mean water temperatures are almost indistinguishable (Figure 2). Water temperatures are within the suitable range for salmonid production both below the reservoir and in the three tributaries above based on individual water temperature measurements taken during riparian surveys in mid summer, 1990.

Water Temperature Summary - South Fork Mill Creek

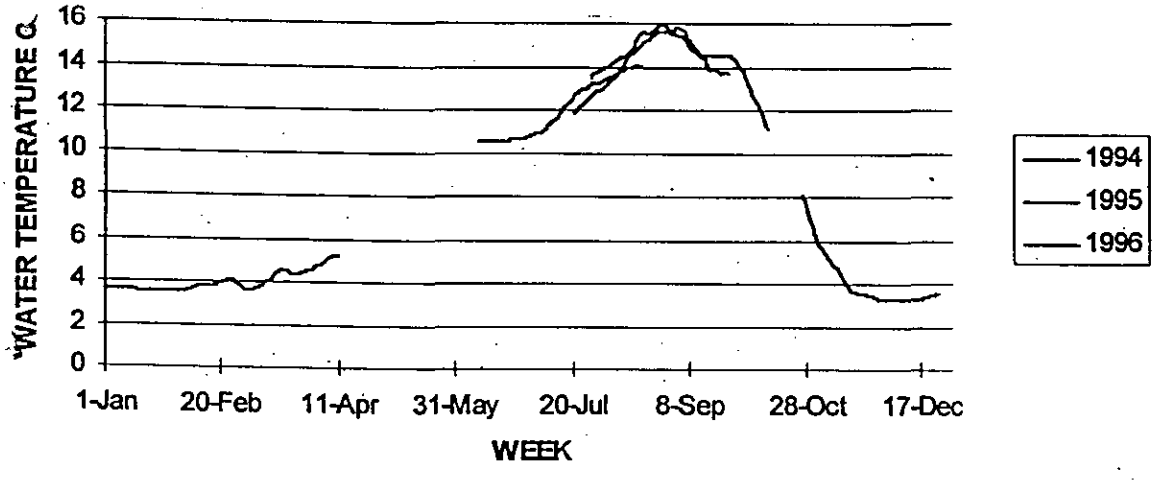
Summer, and some winter, water temperatures were recorded in South Fork Mill Creek below Crow Creek Dam from 1994 - 1996 by MHNF personnel. Water temperatures were monitored to see whether water temperatures were in the suitable range for salmonids and to determine if MHNF Land and Resource Management Plan standards and guidelines and State of Oregon water temperature standards were being met.

During the 1994 - 1996 period, water temperatures did not exceed State of Oregon water quality standards (Table 2). Note the water temperature recording device was not in place the entire summer for each of the three years, but based on the available data it is unlikely that water temperatures in early summer in 1994 and 1996 exceeded state standards. There is a possibility that water temperatures in late summer/early fall in 1995 could have exceeded the standard but this is unlikely because water temperatures in July and most of August in 1995 were less than those in 1996 and 1994 (Figure 1). Although records are incomplete it appears water temperatures overall were higher in 1994 and 1996 compared to 1995. More than likely this was due to warmer air temperatures those two summers.

Table 2. Number of days water temperatures in South Fork Mill Creek below Crow Creek Dam exceeded State of Oregon temperature standards (7 day average maximum) and Mt. Hood National Forest standards (daily maximum) during 1994 - 1996.

YEAR	1994	1995	1996
START DATE	7/21/94	1/1/95	7/29/96
END DATE	12/31/94	8/25/95	10/1/96
DATA DAYS	156	184	65
7 Day Average Maximum > 17.8 °C, 1/1 to 12/31	0	0	0
7 Day Average Maximum > 12.8 °C, 3/1 to 7/15	0	0	0
Daily Maximum > 14.4 °C, 1/1 to 12/31	43	0	30

Figure 1. Seven day average maximum water temperatures in South Fork Mill Creek below Crow Creek Dam from 1994 - 1996.



Survey and Manage Species (Mollusks)

Only two aquatic survey and manage mollusk species listed in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (1994) are known to occur on the Mt. Hood National Forest. Both of these species are covered under survey strategies one and two, manage known sites and survey prior to activities to be conducted after 1999, respectively. The basalt Juga *Juga (Oreobasis) n. sp. 2* is found in perennial springs with gravel substrates and likely feeds on periphyton and perilithon. Occupied springs are sometimes surrounded by basalt talus. The Columbia duskysnail *Lyogyrus n. sp. 1* is found in cold, well oxygenated springs on soft substrates (sand/silt). Preferring slow water areas this snail appears to feed upon decaying organic matter. Threats to both species include timber harvest, road building, and fire. It is possible both of these species are present within the watershed but surveys have not been conducted. Potential habitat is likely present however.